

CHARACTER TRAITS AS FACTORS IN INTELLIGENCE TEST PERFORMANCE

BY
WILLIAM M. BROWN, Ph. D.

ARCHIVES OF PSYCHOLOGY

EDITED BY R. S. WOODWORTH

No. 65

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WILLIAM M. BROWN.

New York City,
May, 1923.

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Character Traits as Factors in Intelligence Test Performance

CHAPTER I

INTRODUCTION

Tests of intelligence have in the past twenty years been developed to a comparatively high degree of efficiency. Trade tests, vocational tests, and tests for other purposes have followed rapidly in their wake, one after another, and while these are still largely in the experimental stage, they are nevertheless being used with satisfactory results in many cases. The testing method in general is not without its opponents, but in most quarters it may be said to be in favor. Those who oppose it seem to criticise not the idea itself but rather the manner of interpreting the results in actual practice. Newspaper and other writers often attribute the errors of interpretation to the psychologist, when, as a matter of fact, it is usually the inexperienced person who becomes superficially acquainted with the tests and immediately begins to regard them as a panacea for most of the evils of our educational and industrial systems. Certain it is, that no psychologist of repute would make such claims for intelligence tests or any other kind of tests.

Many of the criticisms directed against intelligence tests as such indicate, among other things, considerable confusion existing in the minds of the writers as to the meaning and uses of the term "intelligence." Even if we accept the ordinary more or less vague significance attached to the word, we still have to inquire what other factors enter into the performance of a given individual on an intelligence examination. Intelligence, taken by itself, is probably not the sole factor in any activity involving the human organism, and it would be interesting to know what other factors enter into

any given performance. But most performances are only slightly, if at all, analyzable by the means which we at present have at our command. Many writers have mentioned "knowledge" and "acquired skill" as being worthy of investigation. It would be better if the English language allowed for the use of the plural in these cases—"knowledges" and "skills"—as do the Latin and other languages; for each thing known is a specific "knowledge," and there are as many "skills," comparatively speaking, as there are things to be done.

Thus, when an individual goes through the routine of an intelligence examination, it would seem quite obvious that elements in his make-up other than intelligence are brought into play by him. There are, of course, the physiological mechanisms involved in writing the answers to the test questions, the continuation of the nutritive processes of the body, etc. But there are likewise certain character traits quite as evident, call them "predispositions," "the personal equation," or whatever we will. Such factors as perseverance, conservatism, interest, aggressiveness, and the like are commonly thought of as distinct from intelligence, though perhaps not inseparable from it, i.e., the one never operates entirely to the exclusion of the other. If, as we have suggested, "knowledge" and "acquired skill" are fit subjects for study in and of themselves, the same may be said of certain well recognized character traits.

The present study undertakes to point out some of these traits, usually distinguished from intelligence as such, which nevertheless seem to be quite closely connected with performance on intelligence tests. While our present mental examinations undertake to measure only intellectual ability, there is also need of measures of character factors. Granted that some of these factors at least, if not all of them, enter into any intelligence examination, it is conceivable that we may in the future be able to devise a single "comprehensive examination" which will measure objectively intelligence as well as the more important traits of character at one and the same time. Perhaps this is one of the things which the critics most desire. At any rate, the possibilities in this direction seem to offer a promising field for investigation.

CHAPTER II

HISTORICAL SURVEY

From the point of view of most writers on the subject, personality is composed of two great classes of traits, designated as *intelligence* and *character* respectively. Whether we adopt the Freudian view, which regards personality as a unit, or that of others who hold that it is only a combination of separate but closely interwoven traits, or accept a compromise view that personality, rather than being a strictly unitary affair, is merely a "functional unit" as far as the normal person goes, we still find that the purely intellectual factors are generally distinguished from those which, as we say, "go to make up character." There is no clear line of distinction between the two; indeed in many cases they seem to overlap. But, as has already been pointed out, the difference is one which is commonly recognized, not only by the layman, but by the psychologist as well.

In a recent symposium on intelligence¹, participated in by thirteen eminent psychologists, all but one defined intelligence as something more or less distinct from character and eight out of the thirteen pointed out that the systematic investigation of character traits was one of the most needed things in the extension of the use of tests to other fields. In this connection Prof. Haggerty says:

"The work of Dr. Downey on the *Will Profile* suggests that the objective measurement of non-intelligence traits is possible. Probably nothing would better supplement our intelligence examinations than would the perfection of an objective measure of the so-called character traits."

And Prof. Thurstone pertinently remarks:

"It is high time we quit justifying ourselves as psychologists by simply standardizing mental tests. If we attack the individual diagnosis of character traits as energetically as we have been giving group tests, the results will be of far reaching psychological, educational, and social significance."

Similarly, Poffenberger² points out that a high degree of

¹"Intelligence and Its Measurement: A Symposium." Jour. of Ed. Psych., 1921, 12, 123-147 and 195-216.

²Poffenberger, A. T., "Measures of Intelligence and Character." Journ. of Phil., Psych., and Sci. Methods, 1922, 19, 261-266.

intelligence does not always guarantee the same degree of character and that, for some lines of work, a high intelligence rating is by no means necessary, though a good character is always a desirable prerequisite. He says:

"To refuse an occupation in business and industry to all persons with an intelligence under seventy per cent. of normal, without examination of their character qualities, may some time appear to be one of the greatest of human and economic wastes. In the individual of low intelligence but stable character qualities may lie a partial remedy for the restlessness induced by extreme specialization and automacy of work."

Jastrow³ uses the phrase "character and temperament" as a composite term which for him "reflects the two pervasive molding forces: that of native endowment, and that of acquired capacity in adaptation to circumstances; the latter in relation to a composite world which is in part the issue, in part the field of operation, of human qualities" (p. 1). His definition of "traits" is also interesting. He says:

"Traits are issues of original and definite responsive tendencies of the nervous system; they represent functional trends or aids, and get their meaning from the part which they play in natural situations and the complications both naturally and artificially arising from them. Traits, as they come to be recognized and named, owe their selection to their conspicuousness, which reflects the interest in observing them—the interest itself reflecting their practical importance in human conduct." (p. 20.)

Woodworth⁴ defines character as

"The more or less organized sum total of native and acquired tendencies to reaction, with emphasis on those reactions which affect one's life and social relations in a broad way." (p. 529.)

Warren⁵ makes character a "general attitude" which results from the interworking of various attitudes in each sphere of experience. For him character forms the background of our subjective mental life and is to be observed objectively through behavior.

Pillsbury⁶, without undertaking to define character, implies a distinction between it and intelligence in the statement that "character is closely correlated with intelligence."

³Jastrow, J., "Character and Temperament." New York, 1915.

⁴Woodworth, R. S., "Psychology: A Study of Mental Life." New York, 1921.

⁵Warren, Howard C., "Human Psychology." Boston, 1919.

⁶Pillsbury, W. B., "Essentials of Psychology." New York, 1920. (Revised Edition.)

McDougall⁷ makes instincts the fundamental basis of character, as the following quotations will show:

"The innate tendencies to thought and action constitute the native basis of mind."

"With the development of ideational life (or, in physiological terms, of the cerebral cortex) the various instincts become organized in systems and, with the development of self-consciousness, all these become organized and duly subordinated within the all comprehensive system which is the character of the individual man."

"The organization is affected through interrelation of the cognitive dispositions with which the affective or conative dispositions of the instincts have become connected through experience."

In conclusion he adds:

"I have attempted at length to show how the instinctive forces are modified and controlled; but without ceasing to be the mainspring of all our thought and conduct, through becoming organized in the one system which is character."

Many other writers might be quoted in this connection, but enough has been said to show that, however each may define the terms "intelligence" and "character" as such, there is comparative unanimity in distinguishing between the two for all practical purposes.

Rugg⁸ in a recent series of articles published in the *Journal of Educational Psychology* asks, "Is the rating of human character practicable?" He proceeds to answer the question "Yes," but adds that present methods are nearly all fallacious. He points out discrepancies in the ratings of army officers during the World War and urges the use of subjective methods rather than those which are more objective.

Character has long been spoken of in a more or less general way, but scientific studies of character traits are not numerous. After Sir Francis Galton and certain continental investigators, Prof. Karl Pearson⁹ was one of the first to make a study of the matter. He had teachers rate the children in their classes for such traits as shyness or self-assertiveness, etc. Heymans and Wiersma¹⁰, in the years 1906-1908, pub-

⁷McDougall, William, "Instinct and the Unconscious." Brit. Journ. of Psych., 1919, 10, 35-42. See also the same author's more recent expressions on the subject in his "Outline of Psychology." New York, 1923.

⁸Rugg, H. O., "Is the Rating of Human Character Practicable?" Journ. of Ed. Psych., 1921, 12, 425-438, 485-501; 1922, 13, 30-42, 81-93.

⁹Pearson, Karl, "On the Laws of Inheritance in Man, II. On the Inheritance of Mental and Moral Characters in Man," etc. Biometrika, 1904, 3, Part I, 131-190.

¹⁰Heymans, G. and Wiersma, E., "Beiträge zur speziellen Psychologie auf Grund einer Massenuntersuchung." Zeitschrift für Psychologie, 1906, 42, 81-127, 258-301; 1906, 43, 341-373; 1907, 45, 1-42; 1908; 46, 321-333.

lished the results of a more exhaustive similar study, in which individuals were rated for more than ninety traits by persons of their acquaintance. The investigators were more interested in sex differences and found that, according to the judgments obtained, the sexes differed widely in some traits, while there seemed to be no apparent difference in respect to others.

One of the most interesting studies is that of Ach¹¹, reported in 1910. He attempted to classify temperaments on the basis of will-activity. He distinguishes between (a) the phenomenological side and (b) the dynamic side of the act of will, and for him will seems to be an independent and fundamental entity.

Following Ach's study came that of Hart and Spearman¹², who conclude that there is a general factor, 'g,' as well as a specific factor in every intellectual performance. They define the general factor as a "common fund of energy," this energy being described by the term "intellective."

Webb¹³ has made an attempt to analyze character as a whole, and bases his work on the conclusions of Ach and of Hart and Spearman. His investigation is noteworthy in that he finds two general factors at the foundation of all human nature. The 'g' factor of Hart and Spearman is taken as being fundamental to all intelligence, and a 'w' factor is introduced, which, according to him, exerts "a widely ramifying influence on the side of character."

Of it he says:

"Its generality has been demonstrated.

"It markedly dominates all the correlations yielded by the estimates of moral qualities, the deeper social qualities, perseverance, and persistence; also, on the negative side, qualities related to instability of the emotions and the lighter side of sociality.

"*Its nature is best conceived, in the light of our present evidence, to be in some close relation to 'persistence of motives'; i.e., to depend upon the consistency of action resulting from deliberate volition, i.e., from will.* It thus appears to coincide with Ach's conception of will more than with either 'perseveration' or the 'secondary function.' Further evidence is necessary."

¹¹Ach, N., "Ueber den Willensakt und das Temperament." Leipzig, 1910.

¹²Hart, B. and Spearman, C., "General Ability: Its Existence and Nature." Brit. Journ. of Psych., 1912, 5, 51-79. See also the article by the same authors, "Mental Tests of Dementia," Journ. of Abnorm. Psych., 1914, 4, 219-221.

¹³Webb, E., "Character and Intelligence: An Attempt at an Exact Study of Character." Brit. Journ. of Psych., Mon. Suppl., 1915, 1, No. 3.

In 1914 Yerkes and LaRue¹⁴ published an exhaustive outline for the systematic study of the self. The attempt is made to have the individual summarize the main facts relating to (1) the ancestral history of the self; (2) the development or growth of the self; (3) the self of today; and (4) the significance of the characteristics of the self. The questionnaire method is used throughout, and under temperament and character are listed more than 65 pairs of items on which the individual is required to rate himself.

Wells¹⁵ has attempted somewhat the same thing and regards personality as "an ensemble of characters ordinarily regarded as much dominated by hereditary influence." In his *Mental Adjustments* he gives an excellent summary of many of the tests designed to determine the degree of mental balance of a given individual (see Chapter 7).

Fernald's¹⁶ view of character is not essentially different from that of Webb¹⁷. He points out that character is a major mental function and makes it one of the "two essential, interdependent, inextricable components of mentality." For him it is the same as "moral force" or "stamina." Intelligence is the primary function of thought and character bears the same relation to action. He gives a considerable list of subordinate mental functions and comments as follows:

"For the purposes of mentality study, intelligence may be conceived as the thinking, inventing, selecting, combining, planning, deciding function of mentality and character as the complementary function. Character, then, is the emotivating, feeling, sentimental, instinctive, sustaining, energizing, executing or vetoing function of mentality, and as such it is integral. Intelligence being the directing factor is responsible for its own product—decision; and character being the energizing force is responsible for its own product—action. Habit is a factor in both these functions, but a controlled factor, i.e., it may be influenced by the will. Volition and inhibition, though under direction of intelligence, owe their force to character. Sentiment, emotion, and conscience are related to character rather than to intelligence and both the latter are inseparable parts of one whole—mentality. If intelligence be regarded as the judicial department of the mind, then character is truly the executive."

¹⁴Yerkes, R. M. and LaRue, D. W., "Outline for the Study of the Self." Cambridge, 1914.

¹⁵Wells, F. L., "The Systematic Observation of the Personality—in its Relation to the Hygiene of Mind." *Psych. Rev.*, 1914, 21, 295-332; also "Mental Adjustments." New York, 1917.

¹⁶Fernald, G. G., "Character as an Integral Mentality Function." *Mental Hygiene*, 1918, 2, 448-462; also "Character vs. Intelligence in Personality Studies." *Journ. of Abn. Psych.*, 1920, 15, 1-11.

¹⁷Webb, E., op. cit.

Elsewhere he says:

"Intelligence tests, which neglect an investigation of behavior, may fail, then, to demonstrate not only character, an important part of personality; but they may fail also of a complete demonstration of intelligence, since its quality is omitted. An investigation of character, as an integral field of inquiry in addition to the determination of intelligence age level, however, enables the evaluation of the whole personality—presuming freedom from mental disease."

F. H. and G. W. Allport¹⁸ have undertaken to point out and evaluate certain "fundamental and pervasive tendencies which constitute the main currents of human personality." These are subdivided into four main groups: (1) intelligence; (2) temperament; (3) self-expression; and (4) sociality. Each trait is carefully defined and differentiated from the others as far as possible, and the authors seem to find two main types of personality: (1) the strong type of personality (extroverted), and (2) the weak type of personality (introverted)¹⁹.

Hollingworth²⁰ in his *Judging Human Character* summarizes much of the literature of the subject and very pertinently distinguishes between the perception of character and the judgment of character. On this subject he says that the perception of character is fairly easy but the rating, estimating, and judging of character are very difficult because of lack of objective standards of measurement. His relatively simple definition of character is worth quoting:

"By character we mean essentially the characteristic modes of behavior, the characteristic attitudes, reactions, and capacities. * * * The character of a man is not some hidden substance or possession, nor is it a mysterious spiritual essence. A man's character is his actual behavior, when all of his conduct is considered. Lovableness is just the degree to which people are fond of us; kindness and benevolence are present to just the degree that people are actually gratified and comforted by our conduct." (pp. 2 and 3.)

Hollingworth discards the traditional methods of rating character and advocates the empirical procedure or method of correlation. He says:

"It (the empirical method) is the final method that must be applied to test the validity of any presumed criteria of character. Especially from

¹⁸Allport, F. H. and G. W., "Personality Traits: Their Classification and Measurement." *Journ. of Abn. Psych. and Soc. Psych.*, 1921, 16, 6-40.

¹⁹This classification of "extrovert" and "introvert" has also been used by other writers, e.g., William McDougall. Cf. his book, "Is America Safe for Democracy?" New York, 1921.

²⁰Hollingworth, H. L., "Judging Human Character." New York, 1922. Cf. also the same author's "Vocational Psychology," New York, 1916, and "Experimental Studies in Judgment," *Archives of Psychology*, 1913, No. 29.

the point of view of character judgments in vocation and industry, the method has a twofold advantage. At the same time that it identifies the traits of the individual that signify successful work, it indicates, although it may not name, the aptitudes which the execution of that work involves. It is thus, at the same time, a method of character judgment and a technic for job analysis." (pp. 177-178.)

The empirical method, as above described, is also used in the statistical interpretation of the results in the present study.

From the consideration of the preceding more or less general studies of character we pass to a brief discussion of some of the studies which have been made of specific character traits. The association methods, as employed by Jung²¹ and others for the discovery of emotional "complexes," is well known. Jung distinguishes four types of responses, among which the "predicate type" is characterized by the prominence of the emotional element in the response word. He adds that this excessive emotional expression conceals or overcompensates an emotional deficiency. Wells²² refers to the predicate type as the "egocentric type," and says:

"The number of these 'egocentric' associations has been thought, with reason, to bear a peculiar relation to the subject's general personality. * * * This type of response indicates a greater 'loading' of the experiment with affect; and, as the affect is there to be loaded, it is evidently not taken care of elsewhere in the personality."

The well known Kent-Rosanoff²³ and other tests of the same character do not call for a description here.

Woodworth²⁴ has devised a test for emotional instability consisting of 116 questions. Hollingworth²⁵ reports the use of this test for the study of motivation among army psychoneurotics, and unmistakable changes were noted in the same individual before and after the armistice was signed. Langfeld²⁶ studied the judgment of emotions from facial expres-

²¹Jung, C. G., "The Association Method." *Amer. Journ. of Psych.*, 1910, 21, 219-269. Cf. also his "Analytical Psychology," London, 1920.

²²Wells, F. L., "Mental Adjustments," pp. 261 ff.

²³Kent, G. and Rosanoff, A. J., "A Study of Association in Insanity." *Amer. Journ. of Insan.*, 1910, Nos. 1 and 2. Cf. also Whipple, G. M., "Manual of Mental and Physical Tests," Vol. II, Test 33A, pp. 53 ff.

²⁴Reported in Franz, S. I., "Handbook of Mental Examination Methods," New York, 1919, pp. 170-176.

²⁵Hollingworth, H. L., "Psychology of Functional Neuroses." New York, 1920. Chapter 8, "The Role of Motivation."

²⁶Langfeld, H. S., "The Judgment of Emotions from Facial Expressions." *Journ. of Abn. Psych.*, 1918, 13, 172-184. Cf. also the same author's "Judgments of Facial Expression and Suggestion," *Psych. Rev.*, 1918, 25, 488-494, and "The Study of Personality," *Proceedings Brit. Assn. for Adv. of Sci.*, 1921, 447.

sions as found in photographs and found that many subtle combinations could be observed by his judges. There was a wide range of ability in interpreting emotions from facial expressions and some individuals appeared to be very suggestive in this regard. Feleky²⁷ obtained like results from the same kind of experiment, except that her judges were not able to make as fine discriminations as reported by Langfeld. The Pressey²⁸ "Cross-Out" tests have been devised for testing the emotional status of individuals, either singly or in groups.

The relation of character to handwriting has been the subject of a number of investigations. Binet²⁹ became interested in the matter and used various tests of the ability of subjects to judge character from handwriting. He concludes:

"On pourrait dire, introduisant ici une distinction nécessaire, que les signes graphiques d'intelligence ont une réalité incontestable, mais ne concordent pas nécessairement et constamment avec une grande intelligence, quoique cela arrive le plus souvent." (p. 100.)

Again he says:

"Qu'il s'agisse du sexe, de l'âge, de l'intelligence ou même (ce dernier point avec plus de réserve) qu'il s'agisse du caractère, nous arrivons toujours à la même conclusion." (p. 252.)

Hull and Montgomery³⁰ tested ten criteria of handwriting by comparing them with the judgments of close associates of the individuals furnishing the specimens. They obtained only correlations such as might result from chance arrangements. The *Downey Will Profile*³¹ also depends upon characteristics found in handwriting. The author describes the test as follows:

"The series includes speeded, retarded, disguised, blocked, and automatic handwriting, slow and rapid imitation of script, and speeded writing in a restricted space. In many cases the reaction from this set of tests is somewhat definitely patterned. A relatively high score on the first four tests indicates a quick, flexible reaction; on the second four tests, it suggests an aggressive reaction; on the last four, a deliberate, methodical, careful reaction."

²⁷Feleky, A. M., "The Expression of Emotions." *Psych. Rev.*, 1914, 21, 33-41.

²⁸Pressey, S. L. and L. W., "'Cross-Out' Tests, with Suggestions as to a Group Scale of the Emotions." *Journ. of Appl. Psych.*, 1919, 3, 138-150. Cf. also Pressey, S. L. and Chambers, O. R., "First Revision of a Group Scale for Investigating the Emotions," etc. *Journ. of Appl. Psych.*, 1920, 4, 97-104.

²⁹Binet, A., "Les Révelations de l'écriture," Paris, 1906.

³⁰Hull, C. L. and Montgomery, R. B., "An Experimental Investigation of Certain Alleged Relations Between Character and Handwriting." *Psych. Rev.*, 1919, 26, 63-74.

³¹Downey, J. E., "The Will Profile: A Tentative Scale for Measurement of the Volitional Pattern." *Univ. of Wyoming Bull.*, 1912, 16, No. 4.

The author feels that the method may be "used to advantage not only in getting the general temperamental pattern of an individual, but also in determining the specific combination of traits." She realizes the necessity for determining the part played in a given performance by factors other than those which are purely intellectual, adding that, in conjunction with intelligence tests, the "*Will Profile* test certainly affords in many situations a basis for conservative prophecy."

Moore and Gilliland³² undertook to measure aggressiveness by a set of tests including eye control in personal interview; distraction, while adding, by staring, by electric shock, and by a snake; and association responses to certain critical stimulus words. Of these, the eye control test is the most important and counts for one-half the total possible score. The authors conclude from their investigation of college students that these tests "approximate a true measure of aggressiveness more nearly than does the Army Alpha approximate the measurement of intelligence." Perhaps many would question this statement, however.

Brown³³ studied individual and sex differences in suggestibility and concludes that there is a common trait, "suggestibility," which appears in a variety of circumstances and which is more conspicuous in women than in men. Among individuals of the same sex there seems to be a less marked difference, but the results indicate in many cases a "tendency in certain individuals to be suggestible or to resist suggestion." Whipple³⁴ describes various tests of suggestibility, and Miss Otis has also devised a suggestibility test which has not yet been published.

Fernald³⁵ describes a test for discovering the moral sense of an individual by having him rate ten offenses in order of gravity. This test was tried with three groups of persons—a reformatory group, a normal school group, and a group with some experience along the line of offenders and their offenses. He found that the deficiency in moral conduct was to some

³²Moore, H. T. and Gilliland, A. R., "The Measurement of Aggressiveness." *Journ. of Appl. Psych.*, 1921, 5, 97-118.

³³Brown, Warner, "Individual and Sex Differences in Suggestibility." *Univ. of Calif. Publications in Psych.*, 1916, 2, No. 6.

³⁴Whipple, G. M., op. cit., Vol. II, Chapter 10.

³⁵Fernald, G. G., *Amer. Journ. of Insanity*, 1912, 68, 547.

extent reflected in a deficiency of moral sense, but could not determine how close the correspondence actually was. Wells³⁶ performed a similar experiment in 1913 with a group of ten normal women (nurses). An attempt was made to discover whether differences in personality appeared in judgments of moral value. The results were decidedly negative, and Wells concludes that "features making for a 'normal' judgment are not essentially effective in determining mental balance."

The preceding review of some of the work which has been done along the line of character investigation makes no pretense at being complete. A more comprehensive bibliography, appended to the present work, includes various additional titles of studies which have been made in this field.

In the following pages I have aimed at an investigation of some of the facts connected with "caution" as a trait of character, which seems to be but one of many such traits manifesting themselves in an individual's intelligence test performance. Further details as to the meaning in which I use the term are given in Chapter IV, and, so far as I am aware, this particular trait has not been previously investigated.

Enough has been said to show that the study of character and its elements is one that is much needed in our present day methods of applying psychology to the solution of practical problems. The field is so vast that much more research must be carried on before we can say that we have a satisfactory objective measure of any given trait. The following quotation from the report of an investigation already referred to³⁷, will serve to indicate the status of the matter at the present time:

"Present classification and research is to be regarded as but the beginning of the investigation of personality. The development of a complete and satisfactory instrument of individual measurement for personality, as well as for intelligence, is a distant but perhaps not unattainable goal. Progress must be made along two lines: first, the theory and genetic study of personality and the isolation of recognizable traits which are truly fundamental; and second, the practical technique of refining impressions in the rating of individuals and of devising crucial tests of the various traits."

³⁶Wells, F. L., *op. cit.*, pp. 253-4.

³⁷Allport, F. H. and G. W., *op. cit.*, p. 40.

CHAPTER III

PRELIMINARY STUDY

The facts presented in the preceding chapter serve to show that, while there is no hard and fast line between intelligence and character, common parlance sanctions the use of the two terms to designate aspects of the personality which differ from each other in some degree at least. And, while we have many tests which claim to measure intelligence in one or another of its phases, character seems to present a more intangible field for experimental study. There are, therefore, correspondingly fewer tests for the measurement of character traits. Some of these have already been mentioned, but it cannot be said that any one of them is wholly satisfactory for the purposes for which it is intended.

The important point to note in all this, however, is the fact that an individual's performance on an intelligence test, as well as elsewhere, practically always involves the exercise at the same time of certain character traits, and, conversely, certain intellectual factors must almost inevitably play some part in the performance on any test of character traits. Hence, it is reasonable to assume that every test, whether it is intended primarily to test character or intellectual factors, at the same time presents opportunities to the individual to demonstrate the presence or absence of some one or more factors belonging to the other class. The greatest difficulty here consists, of course, in finding objective evidence of traits which are not specifically tested by the examination in question.

In this preliminary study the attempt has been made to evaluate the various types of scores to be found in the Thorndike intelligence examination and to examine each type as a possible indicator of some more or less well recognized character trait.

Description of the Thorndike Intelligence Examination

The test as devised by Professor Thorndike and first used in 1919 was entitled: *The Thorndike Intelligence Examination*.

*tion for High School Graduates*³⁸. It was divided into three parts, designated respectively Part I, Part II, and Part III. Of these, Part I was largely a speed test and was further subdivided into two subtests which are similar, and therefore comparable, throughout. Parts II and III, on the other hand, were intended to test the judgment, ingenuity, comprehension, and ability for discrimination of the subject, less emphasis being placed on speed. The general character of each test included in the examination may be seen from the table below, which also includes the number of items, or "elements," composing the test.

TABLE 1

(Showing the character and number of items included in the Thorndike intelligence examination, edition of 1919.)

| PART I, FORMS 1 AND 2 | | |
|------------------------|------------------------------|-------------------------------|
| <i>No. of Test</i> | <i>Description</i> | <i>Total No. of Items</i> |
| 1 | Following Directions | 5 |
| 2 | True-False (Easy) | 10 |
| 3 | Arithmetic (Easy) | 8 |
| 4 | Problems (Hard) | 10 |
| 5 | Information | 10 |
| 6 | Synonyms and Antonyms | 20 |
| 7 | Reasoning | 5 |
| 8 | Number Series | 10 |
| 9 | Mixed Relations | 20 |
| 10 | Cancellation | 9 |
| 11 | True-False (Hard) | 8 |
| 12 | Logic | 8 |
| 13 | Identification (Recognition) | 20 |
| Total | | 143 |
| Total in both forms | | 286 |
| PART II | | |
| <i>No. of Test</i> | <i>Description</i> | <i>Total No. of Items</i> |
| 1a | Comprehension (Reading) | 6 |
| 1b | Comprehension (Reading) | 6 |
| 2 | Sentence Completion | 12 |
| 3 | Object Completion | 10 |
| 4 | Mixed Relations | 8 |
| 5 | Mixed Relations | 10 |
| 6 | Algebra Problems | 6 |
| 7 | Mechanical Information | 10 |
| 8 | True-False (Information) | 60 |
| Total | | 128 |

³⁸For a more complete description of the Thorndike intelligence examination, the reader is referred to "Measurement in Higher Education," by Dr. B. D. Wood, Yonkers, 1923.

| PART III | | |
|------------------------------|-------------------------|-------------------------------|
| <i>No. of Test</i> | <i>Description</i> | <i>Total No. of Items</i> |
| 1a | Comprehension (Reading) | 6 |
| 1b | Comprehension (Reading) | 6 |
| 2 | Sentence Completion | 12 |
| Total | | 24 |
| Total for entire examination | | 438 |

As can be seen from Table 1, the various individual tests of the examination were intended to apply to many different aspects of the subject's "intelligence," and the results may, therefore, be taken as prognostic in a very general way as to what he might be expected to do in each particular line. The more important tests may be grouped as follows³⁹:

| | |
|---------------|---------------------------|
| Language | Part I, tests 1, 2, 6, 11 |
| Mathematics | Part I, tests 3, 4, 8 |
| | Part II, test 6 |
| Information | Part I, test 5 |
| | Part II, test 8 |
| Comprehension | Part II, tests 1a, 1b |
| | Part III, tests 1a, 1b |
| Trades | Part II, test 7 |
| Completion | Part II, test 2 |
| | Part III, test 2 |
| Logic | Part I, tests 9, 12 |

The remaining tests cannot well be classified under any one of the above heads, and so may be said to have rather a general than a specific application⁴⁰.

Scoring the Examination

The method of scoring the items in the Thorndike examination is a somewhat complicated one as compared with that used for many intelligence tests. Each item is properly weighted by being given an assigned value, which is proportionate to the importance and difficulty of the item itself. In most instances part credit is given where the answer is only partially correct, though this is not done for any of the tests of Part I. In some tests minus and zero scores have been introduced, while in others only the items done correctly are considered. The situations involved in these two cases are quite different, however. In the tests where no

³⁹Data from unpublished notes of Dr. Wood.

⁴⁰In passing it may be said that the results of the examination are in many cases actually classified under the above-mentioned heads and are used by the dean's office of Columbia College in advising with students regarding their particular problems.

deduction is made for inaccuracies the subject is merely given directions as to what he is to do, and sometimes guessing is encouraged by the assurance that no penalties will be inflicted for wrong answers. Where minus and zero scores are given, on the other hand, the subject is not only told what he is expected to do, but he is warned that wrong answers will cause a deduction from his total score. He must, therefore, choose between putting down answers of whose correctness he is quite sure and, in addition, either guessing at other items or leaving them blank. Table 2 shows the assigned value of each item included in the examination.

TABLE 2

(Showing the maximum scores which may be obtained on each item of the Thorndike intelligence examination. Where no value is entered in the column headed "Minus," it is to be understood that no minus or zero scores are possible for those particular items.)

| <i>Part</i> | <i>Item</i> | <i>Maximum Value</i> | |
|-------------|-----------------------|----------------------|--------------|
| | | <i>Plus</i> | <i>Minus</i> |
| I | Tests 1, 2, 3, 5, 6 | 1 | — |
| I | Tests 7, 8, 9, 10, 11 | 1 | — |
| I | Tests 12, 13 | 1 | — |
| I | Test 4 | 2 | — |
| II | Test 5 | 2 | — |
| II | Tests 3, 4 | 2 | -1 |
| II | Tests 1a, 1b, 2 | 3 | -2 |
| II | Test 8 | 3 | -3 |
| II | Test 7 | 4 | -2 |
| III | Tests 1a, 1b, 2 | 4½ | -3 |
| II | Test 6 | 5 | — |

An inspection of the above table shows that the subject was always given more credit for answering a question correctly than he was given discredit, or penalized, for a wrong answer to the same question. The maximum plus values range from 1 to 5, and the maximum minus values from -1 to -3. No zero scores as such were given in the tests where minus values also were not possible, and all incorrect answers as well as all items not attempted were in these cases disregarded in computing the score. On the contrary, the introduction of minus scores into certain tests made a zero value, as a possibility, also necessary, and the scorer was required in these cases to rate each item on some such scale as the following:

- 3—excellent (entirely correct)
- 2—good
- 1—fair
- 0—neutral (neither right nor wrong)
- 1—slightly wrong
- 2—distinctly foolish
- 3—foolish and irrelevant (entirely wrong)

It will also be seen that each test has been given a definite weighting, as previously mentioned, in proportion to its difficulty as compared with the other tests in the examination. This weighting is taken care of by the assigning of different values to each separate item, those items which are of similar character and difficulty being given the same value.

The total maximum score possible in the entire examination is 792. In the tests where minus scores are possible, the maximum plus score is 436 and the maximum minus score is -338.

The "raw" score obtained by any individual taking the examination may be transmuted into a percentage rating by the use of the following formula:

$$\text{Percentage rating} = \text{total examination score} \times .2.$$

Thus, if a person makes a total "raw" score of 358 on the intelligence examination, his percentage rating would be recorded as 71.6; etc.

Obviously it is quite possible for a subject to make more than a percentage rating of 100, but in practice comparatively few individuals ever succeed in passing beyond this point. In any case, a rating of more than 100 per cent. serves merely to indicate that the subject belongs in the extreme upper range of distribution and that, other things being equal, he is a desirable candidate for admission to college.

Theoretically the maximum percentage rating possible is 158.4, but ordinarily the range is from 30 to 120, with the

TABLE 3

(Showing the distribution of scores on the Thorndike intelligence examination as given for September admission to Columbia College for the years 1920-21, 1921-22, and 1922-23.)

| <i>Percentage Rating</i> | <i>1920-21</i> | <i>Session 1921-22</i> | <i>1922-23</i> |
|----------------------------------|----------------|----------------------------|----------------|
| 30-40 | 0 | 2 | 0 |
| 40-50 | 5 | 11 | 1 |
| 50-60 | 24 | 23 | 13 |
| 60-70 | 62 | 94 | 57 |
| 70-80 | 136 | 181 | 136 |
| 80-90 | 107 | 122 | 174 |
| 90-100 | 66 | 63 | 110 |
| 100-110 | 21 | 27 | 28 |
| 110-120 | 3 | 3 | 3 |
| Totals | 424 | 526 | 622 |
| Medians | 79.0 | 78.5 | 80.2 |
| Average Median (for three years) | | 79.2 | |

median at about 80. The data in Table 3 show the distribution of candidates admitted to Columbia College in September for three successive years, beginning in 1920.⁴¹

The significance of the scores obtained in the intelligence examination may be seen from Table 4, which contains Professor Thorndike's interpretation as a result of empirically derived data.

TABLE 4

(Showing the significance of the various scores obtainable on the Thorndike intelligence examination in terms of fitness for college admission.)

| <i>Score</i> | <i>Significance</i> |
|--|--|
| 95 or over (boys) } 90 or over (girls) } 85-95 | Worth admitting in entire disregard of technical difficulties. Intellect enough to do collegiate or professional work with distinction. |
| 70-85 | Intellect sufficient to obtain a college degree. |
| 60-70 | May be admitted if sufficiently in earnest and otherwise desirable. |
| 50-60 | Should be admitted only if of extraordinary zeal or has suffered very great educational handicaps. |
| Less than 50 | Should not be admitted. |

Validity of the Examination

In 1919 Columbia University adopted and put into operation the plan of requiring an intelligence examination of all candidates for admission to Columbia College, the men's undergraduate school of the University. The plan, as at present in force, allows a candidate, whose previous record is satisfactory, to enter college upon making a passing score (usually 70 or over) on the Thorndike intelligence examination. This is known as the "new method" of admission. The "old method" of allowing a candidate to enter by passing college entrance examinations in certain prescribed subjects still obtains, but he is nevertheless required to take the "mental test" as well, in order that his score may be recorded for future reference.

The first class to take the examination as devised by Professor Thorndike entered the University in September, 1919. The results have proved quite satisfactory and are now a permanent part of the admission routine for new students. Similar results have been obtained in the fifty or sixty other

⁴¹From an unpublished study by Mr. Harold K. Chadwick, Assistant Director of Admissions, Columbia University.

institutions where the examination is now used. It should be remembered that a candidate's intelligence rating is only one of several factors which determine whether he shall be admitted or not, and for this reason it should not be given undue emphasis.

Professor Thorndike has stated the object of his intelligence examination as fourfold: (1) to select those fit for a college course; (2) to aid college committees; (3) to assist the progress of schools; and (4) to assist the dean and other officials in the administration of the college.

From the above it will be seen that one of the most important questions for college officials is a determination of the predictive or prognostic value of the tests as regards the probable scholastic performance of a given individual. Usually this is done for a particular test by correlating the individual's score with his scholastic performance. On this basis Wood⁴² has found correlations as high as .672 between scores on the Thorndike examination and the scholastic performance of students in Columbia College.

However, there are other possible lines of investigating the matter. It goes without saying that certain items and tests in every intelligence examination of any length possess more significance than others when the probable scholastic performance of an individual is to be determined. In fact, Professor Thorndike has himself stated to the writer, that he has included in his examination various items which every person taking the test may be expected to do. The general result of this is a certain sense of security on the part of the subject and a corresponding decrease in the amount of "excitement" and "nervousness" which the taking of any kind of examination tends to produce. The subject is thus led to put forth greater effort, with the additional result that he is less likely to "lose his bearings" and make foolish answers to the questions asked him.

In addition to the determining of the predictive value of the various parts of the examination, the relative importance of the plus, minus, and zero scores should be studied for their significance. So far as the writer is aware, Professor Thorndike's intelligence examination is the only one of its kind where minus and zero scores have been introduced. The usual

⁴²Wood, B. D., *op. cit.*

method of scoring is to discard both incorrect and omitted items and to give the individual a certain assigned credit for each item answered correctly. In cases where the effects of chance must be taken into account, the score is usually the number right minus the number wrong (R-W). Thus the possibility of minus and zero scores is, in most tests, entirely eliminated.

It would seem equitable, however, to take into consideration all wrong answers as well as those which are neither entirely right nor entirely wrong. In his method of scoring Professor Thorndike has undertaken to do just this in many of the tests, so that the final score for a given individual is probably a much more accurate index of his intellectual capacity than would otherwise be the case.

In a communication to the writer, Dr. Arthur S. Otis, author of the Otis intelligence tests, raises a question as to the value of introducing minus and zero scores into the Thorndike examination. He says:

"I have often wondered just why Professor Thorndike introduced his negative scores and can see no logical reason for these. Looking at the scoring from a slightly different viewpoint, Dr. Thorndike's method simply amounts to giving slight credit for refraining to put down any answer. For example, suppose a student gets two points for a right answer and minus two points for a wrong answer, with no points for a blank. This amounts to exactly the same thing as if he got four points for a right answer, no points for a wrong answer, and two points for no answer at all. When there is the element of chance to be compensated for, as in the case of the true-false test, I can see a reason for this method of scoring, but in a case of the type of questions used by Professor Thorndike, I really cannot see any reason at all for negative scores."

But Dr. Otis has overlooked a very important point, namely, the fact that the subject in the Thorndike examination is confronted with a situation which is somewhat different from that found in most other intelligence tests. In those parts of the examination where no minus scores are possible, Professor Thorndike encourages the subject to guess by assuring him beforehand in the printed directions at the top of the page, that no deduction will be made for wrong answers. But in the parts where minus scores are given, the situation with which the subject is confronted is entirely different. He is warned that he will be penalized for wrong answers, and much more judgment and discrimination are required in these parts of the examination than is the case elsewhere.

An illustration will serve to make the matter clearer. In Part II, Test 2 (edition of 1919), the following directions are given for sentence completion:

"On each line of dots, write the word or words that make the best meaning. Each sentence completed with entire correctness counts 3. A substantially correct completion will count 1. Two will be subtracted from your score for each foolish or irrelevant completion of a sentence."

In contrast with these directions are those given in many other tests, and, indeed, in some portions of the Thorndike examination, where the subject is given no indication of a penalty to be inflicted in case of a wrong answer. The instructions for the *Otis Self-Administering Test of Mental Ability* contain the following:

"The test contains 75 questions. You are not expected to answer all of them, but do the best you can. You will be allowed half an hour after the examiner tells you to begin. Try to get as many right as possible. Be careful not to go so fast that you make mistakes. Do not spend too much time on any one question. No questions about the test will be answered by the examiner after the test begins."

It is evident, therefore, that the introduction of negative scores presupposes a particular type of situation and may possess greater significance than appears on the surface. A thorough investigation of the matter is needed in order to show whether Professor Thorndike's theory is correct or not.

One further remark should be made regarding the zero scores. While they are entirely disregarded in computing an individual's rating, yet it is safe to say that they should, for the purposes of the present investigation, be interpreted as being of negative significance. Whatever else the zero score indicates, it at least shows that the subject did *not* know the correct answer to the particular question involved, and consequently he should receive a slight penalty, though by no means as great a one as is given for answers which are utterly irrelevant. This statement, however, should not be taken as denying the other side of the matter, namely, that the zero score in many cases doubtless represents a certain degree of achievement, since it is not absolutely wrong. But at present we have no psychological methods for measuring this achievement. Perhaps they may come later, and if so, they will undoubtedly have a wide range of application, e.g. in scoring the results of various methods of testing memory, etc. The scientific determination of the extent of correctness of a

partially correct answer would without doubt revolutionize the present method of scoring intelligence examinations.⁴³

A Formula for the Treatment of the Various Types of Scores

From the preceding discussion it will be seen that any method of scoring the Thorndike intelligence examination must take into account the following factors: (1) the total number of items possible on the tests; (2) the actual number of items attempted by the subject; (3) the number of plus scores made; (4) the number of minus scores; and (5) the number of zero scores. In the ordinary method of scoring the examination, the zero scores are treated in the same way as the items not tried, i.e., they are simply disregarded. The total of the minus scores is then deducted from the total of the plus scores, after the total value of each has been determined, and the remainder is assigned to the subject as his "net" or final score. This is merely the application of the formula referred to above—the score is equal to the right minus the wrong (R-W).

But for research purposes and for determining more accurately the rank of each individual taking the test, a more exact method may be desirable in many cases. For this purpose the following formula is suggested, though it is questionable whether for practical purposes it gives results which vary widely from those obtained by the present "rule of thumb" method of scoring.

Let p represent the total number of right scores where no minus (and consequently no zero) scores are possible;
 also let x represent the total number of plus scores in all tests where minus (and also zero) scores are possible;
 and let y represent the total number of minus scores in the last-mentioned tests;
 and let z represent the total number of zero scores in the same tests.

Now the total maximum score in all the tests where no minus or zero scores are given is 356; and in all the tests where minus scores are possible the total maximum *plus* score is 436, while the total maximum *minus* score (penalty) is only

⁴³I have dwelt thus at length on the Thorndike intelligence examination for three reasons: (1) to furnish the reader with an adequate background for the discussion which is to follow; (2) the Thorndike examination is used chiefly for college entrance and, hence, most persons are not as familiar with its character as with that of the Binet and other more widely used tests; and (3) the make-up of the examination has undergone considerable change during the past three years, so that an inspection of the present forms will not give a correct idea of the forms as used for the individuals included in the present study.

-338, leaving a difference of 98 in favor of the plus scores. This difference is due to the fact, above referred to, that Professor Thorndike has proceeded on the principle of giving more credit for doing a thing correctly than penalizing for doing the same thing incorrectly. In any formula for scoring the tests, therefore, this difference of 98 must be taken into account.

Now in every case where the subject scores zero, theoretically he shows *ipso facto* and he does *not* know the correct answer to the problem. Accordingly, it would probably be a more exact treatment of the zero scores if we should make some small deduction for each, rather than disregard them altogether. It would seem fair, therefore, to equate the zero scores with the differences between the maximum total values of the plus and of the minus scores, giving this difference of 98 a minus or "penalty" significance. Obviously the difference cannot be accounted for in terms of the untried items, since there is no way of determining what the subject might have done *if* he had tried them.

Returning now to the discussion of the formula we have:

| | |
|---|------|
| Total number of items in tests where no minus scores are possible = | 302 |
| Total number of items in tests where minus scores are possible = | 136 |
| Total number of items in entire examination = | 438 |
| Also: Total maximum score obtainable in tests where minus scores are possible = | 436 |
| Total maximum score obtainable in tests where no minus scores are possible = | 356 |
| Hence: Total maximum score obtainable in the entire examination = | 792 |
| Total maximum minus score obtainable = | -338 |
| Total score if all tests where minus scores are possible are scored zero = | -98 |

From the above we have:

$$\frac{356}{302} = 1.179 \text{ (average value of each correct item in tests where no minus scores are possible; cf. "p" above);}$$

$$\frac{436}{136} = 3.206 \text{ (average value of each plus item in tests where minus scores are possible; cf. "x" above);}$$

$$\frac{-338}{136} = -2.485 \text{ (average value of each minus item in tests where minus scores are possible; cf. "y" above);}$$

$$\frac{-98}{136} = -.721 \text{ (average value of each zero item in tests where minus scores are possible; cf. "z" above).}$$

Employing the above values we have an equation for determining the intelligence rating for any individual as follows:

$$\text{Rating} = 1.179p + 3.206x - (2.485y + .721z)$$

For purposes of comparison it was found best to reduce all ratings to a basis comparable to the coefficient of correlation, "r," in which the maximum rating should be 1.000. This result may be easily accomplished by the use of the following:

$$\text{Rating} = \frac{1.179p + 3.206x - (2.485y + .721z)}{792}$$

The rating thus obtained may be called the "intelligence index" as distinguished from the "intelligence score."

Even a casual inspection of the formula will show that no index can be obtained greater than 1 or less than -1. For, if the subject should make a maximum plus score, with no minus and no zero items, the formula would reduce to:

$$\frac{356 + 436 - (0 + 0)}{792} = \frac{792}{792} = 1$$

On the other hand, if the subject made all minus scores, with no plus and no zero scores, we would have the following:

$$\frac{0 + 0 - (338 + 0)}{792} = \frac{-338}{792} = -.427$$

Or, if only the items where minus scores are possible are considered, we would obtain:

$$\frac{0 + 0 - (338 + 0)}{436} = \frac{-338}{436} = -.775$$

Similarly, if all the items in the entire examination were scored zero, the formula would reduce to the following:

$$\frac{0 + 0 - (0 + 98)}{792} = \frac{-98}{792} = -.124$$

Or again, if we consider only the items where minus (and zero) scores are possible, we have:

$$\frac{0 + 0 - (0 + 98)}{436} = \frac{-98}{436} = -.225$$

By way of summary we may indicate the results from the use of the formula as follows:

If all items are correct, the index is 1.000
 If all items are minus, the index is $-.427$ (or $-.775$)
 If all items are zero, the index is $-.124$ (or $-.225$)

We may now arrange the various kinds of items in order of value as follows: (1) plus, (2) omitted, (3) zero, and (4) minus. It is conceivable, however, that in tests of certain types omitted items should be penalized, perhaps more heavily than either zero or minus items, since the subject should, in many instances, receive some credit for attempting an item. This is on the theory that he supposedly knows something about the facts involved in the question though he did not give the correct answer. Under such conditions we might have the relative order of the various kinds of items changed to: (1) plus, (2) zero, (3) minus, and (4) omitted.

Again it may be pointed out that there is some truth in the criticism of Dr. Otis mentioned above. For, instead of assigning the values which Professor Thorndike gives, we might score a minus item zero and change the values of the other items accordingly. A comparison of the present and the suggested methods of evaluation is given below.

| <i>Item</i> | <i>Present</i> | <i>Suggested</i> |
|-------------|----------------|------------------|
| Plus | 3.2 | 5.6 |
| Omitted | 0 | 2.4 |
| Zero | -0.7 | 1.7 |
| Minus | -2.4 | 0 |

Further discussion of the various possible methods of scoring would carry us too far afield for our present purposes.⁴⁴

One further comment regarding the formula may be made. Instead of assigning a value to p, x, y, and z based on the arithmetic average, we may obtain slightly different but more accurate results by weighting the averages according to the proportion of scores to which each value included in the average is assigned (method of weighted averages). Also, by careful manipulation, the average values of p, x, y, and z might be reduced to unity and the fractions eliminated, their

⁴⁴In order to make the intelligence index comparable to the intelligence score, the former should be in every case multiplied by .2, which is the procedure followed in transmuting the intelligence score to a percentage basis.

relative values still remaining the same. Thus, we might assign the following approximate values: $p = 3$, $x = 9$, $y = 7$, and $z = 2$. In any case, these unit values could be made accurate by the proper handling of the items in the examination when it is devised.

It should be repeated that the chief use of the formula may be found in cases where it is necessary to rank the individuals in a given group, to whom the examination is given, in the order of their performance, either for purposes of comparison within the group itself, or, where the group is not too large, for correlating with the criterion by the "rank-difference" method of correlation.

Methods and Results of the Study

In the preliminary study the aim has been to make an investigation of the value of the various kinds of data derived from the Thorndike intelligence examination with especial reference to the relation of plus, minus, and zero scores to the probable scholastic performance of the student. Wood⁴⁵, in the investigation already referred to, has found correlations as high as .672 between intelligence examination scores and the scholastic performance of students in Columbia College. It is reasonable, therefore, to suppose that the number of plus, minus, and zero scores made by any individual taking the intelligence examination should have some predictive value in determining that individual's scholastic performance. But the question was one which required actual investigation before a definite answer could be given to it.

In order to obtain the fullest possible scholastic record for each student investigated, a group of 33 individuals was selected from the class entering Columbia College in September, 1919. This was the first class which took the intelligence examination for satisfying the entrance requirements, and though some individuals preferred to enter under the "old system" of taking college entrance examinations in specified subjects, all candidates for admission were nevertheless required to take the intelligence examination as well. This procedure was followed for the purpose of giving the Ad-

⁴⁵Wood, B. D., op. cit.

missions Office additional information regarding the candidate in question. As a result, since September, 1919, a candidate's intelligence score has been one of the determining factors in his case, there being three other important factors, namely, scholastic record in high school, personal character, and (in a limited number of cases) the age at which the candidate began using English as a domestic language.⁴⁶

The 33 cases which were selected for study all fell within the so-called "border-line" group, and their intelligence scores as taken from the official records ranged from 70.0 to 75.9, a class interval of 6 instead of 5 being selected in order to provide a larger group for study. Any candidate for admission who scores below 70.0 is likely to be rejected unless he seems to be especially deserving from the standpoint of his other credentials; hence, those scoring only a few points above or below this "critical score" may be considered as doubtful or "border-line" cases. The group may be regarded as fairly homogeneous, and the scores made by the individuals included in the group are quite comparable with each other, since the candidates not only took the same examination under the same conditions, but the forms of the examination papers were in every case the same with only one or two exceptions.

In determining the scholastic performance of the group, the attempt was made to obtain the complete record of each person for the years 1919-20, 1920-21, and 1921-22. Where this was impossible, due to the fact that some did not remain in college throughout the full three years but dropped out either temporarily or permanently, only full semester records were taken into account, and all partially complete semesters were discarded.

For purposes of comparison with the other factors concerned, the letter grades as noted on the individual's scholastic record had to be transmuted into numerical equivalents. The following table, which also takes account of all other notations employed by the Registrar's Office, and which is

⁴⁶Compare these with the factors mentioned by Burt as entering into the "educational attainment" of English school children: (1) chronological age, (2) school performance, (3) intelligence as measured by reasoning ability, and (4) mental age. Cf. Burt, C., "Mental and Scholastic Tests," London, 1921, p. 187.

based in the main upon a similar table employed by Wood⁴⁴, was used for this purpose.

TABLE 5

(Showing the numerical equivalents of letter grades and other notations used to indicate the student's scholastic performance as entered in the records of the Registrar's Office, Columbia University.)

| <i>Grade</i> | <i>Equivalent</i> | <i>Grade</i> | <i>Equivalent</i> |
|------------------------|---|------------------------------|-------------------|
| A+ | 15 | C— | 7 |
| A | 14 | D | 6 |
| A— | 13 | D+ | 5 |
| B+ | 12 | D— | 4 |
| B | 11 | F+ | 2 |
| B— | 10 | F | 1 |
| C+ | 9 | F— | 0 |
| C | 8 | | |
| <i>Other Notations</i> | | <i>Equivalent</i> | |
| Abs. | (absent from exam.) | Half value at average grade | |
| Dro. | (dropped from class) | 1 | |
| H | (attendance credit only) | Half value at average grade | |
| Inc. | (incomplete) | 1 | |
| N | (no credit allowed for more than one course with grade D) | Full value with grade D | |
| NC | (no credit by reason of irregular attendance) | Half value at grade assigned | |
| NM | (no mark on record) | 1 | |
| Wd. | (withdrawn from course) | 0 | |
| X | (credit conditioned upon satisfactory completion of second half year of course) | Full value at grade assigned | |
| * | (course credited for entrance only) | Full value at average grade | |
| † | (credit reduced for excessive absence) | Full value at grade assigned | |
| ‡ | (credit allowed with warning as to excessive absences) | Full value at grade assigned | |
| § | (credit withheld pending receipt of excuse for absences) | Half value at average grade | |

Using the numerical equivalents given in the above table the method of computing the scholastic index of an individual is as follows:

For each course taken he is credited with the numerical equivalent of the grade obtained in the course multiplied by the number of points at which the course is valued in the current announcement of the University. The total for any one semester is divided by the total number of points carried during the semester, in order to get the semester average. The total of the semester averages divided by the number of

⁴⁴Wood, B. D., op. cit. The table, as here given, has been modified from that originally used by Dr. Wood and conforms more to the revised table which has been used by him since 1922. It may be said that the values assigned to the various letter grades were empirically determined and have been found satisfactory in actual practice.

semesters during which the individual was in residence gives the "general average" for his entire scholastic performance. This average is determined, however, on a basis of 15 (see Table 5). Therefore, it may be reduced to a decimal basis, in order to conform to that of the "intelligence index" and the "intelligence score," by multiplying it by $6 \frac{2}{3}$. This procedure was followed in every case, and the result may be regarded as the "scholastic index" for each person in the group.

The tables given below indicate in condensed form the results of the analysis of the intelligence examination data and the scholastic performance of each of the 33 cases examined. All ratings have been reduced to a basis of 1.000 for the sake of comparison.

TABLE 6

(Showing ratings in intelligence score, intelligence index, and scholastic index with relative rank in each.)

| <i>Individual No.</i> | <i>Intell. Score</i> | <i>Intell. Index</i> | <i>Schol. Index</i> | <i>Order of Rank</i> | | |
|---------------------------|--------------------------|--------------------------|-------------------------|--------------------------|--------------------------|-------------------------|
| | | | | <i>Intell. Score</i> | <i>Intell. Index</i> | <i>Schol. Index</i> |
| 1 | .750 | .568 | .525 | 6 | 29 | 15 |
| 2 | .746 | .682 | .361 | 10 | 15 | 28 |
| 3 | .712 | .678 | .467 | 24 | 16 | 21 |
| 4 | .758 | .674 | .274 | 1 | 17 | 32 |
| 5 | .758 | .712 | .503 | 2 | 12 | 17 |
| 6 | .738 | .758 | .464 | 15 | 4 | 23 |
| 7 | .736 | .786 | .329 | 18 | 2 | 30 |
| 8 | .708 | .706 | .466 | 25 | 13 | 22 |
| 9 | .708 | .636 | .741 | 26 | 21 | 1 |
| 10 | .758 | .742 | .453 | 3 | 7 | 16 |
| 11 | .701 | .726 | .636 | 31 | 19 | 5 |
| 12 | .738 | .698 | .635 | 16 | 14 | 6 |
| 13 | .722 | .666 | .633 | 23 | 18 | 8 |
| 14 | .732 | .588 | .561 | 19 | 28 | 13 |
| 15 | .708 | .596 | .694 | 27 | 26 | 3 |
| 16 | .742 | .634 | .395 | 11 | 23 | 26 |
| 17 | .708 | .598 | .475 | 28 | 25 | 20 |
| 18 | .702 | .486 | .620 | 30 | 32 | 11 |
| 19 | .750 | .664 | .628 | 7 | 19 | 9 |
| 20 | .742 | .474 | .661 | 12 | 33 | 4 |
| 21 | .748 | .758 | .621 | 8 | 5 | 10 |
| 22 | .700 | .596 | .574 | 32 | 27 | 12 |
| 23 | .730 | .724 | .493 | 21 | 10 | 19 |
| 24 | .748 | .772 | .740 | 9 | 3 | 2 |
| 25 | .742 | .636 | .315 | 13 | 22 | 31 |
| 26 | .742 | .606 | .421 | 14 | 24 | 25 |
| 27 | .737 | .814 | .502 | 17 | 1 | 18 |
| 28 | .732 | .514 | .351 | 20 | 30 | 29 |
| 29 | .756 | .756 | .633 | 5 | 6 | 7 |
| 30 | .700 | .718 | .528 | 33 | 11 | 14 |
| 31 | .758 | .660 | .388 | 4 | 20 | 27 |
| 32 | .724 | .730 | .443 | 22 | 8 | 24 |
| 33 | .708 | .504 | .255 | 29 | 31 | 33 |

TABLE 7

(Showing the number of plus, minus, and zero scores made by each individual, with relative rank in each.)

| <i>Individual No.</i> | <i>No. Plus</i> | <i>No. Minus</i> | <i>No. Zero</i> | <i>Mo. Minus & Zero Comb.</i> | <i>Order of Rank</i> | | | <i>Minus & Zero Comb.</i> |
|---------------------------|---------------------|----------------------|---------------------|---|----------------------|--------------|-------------|---------------------------------------|
| | | | | | <i>Plus</i> | <i>Minus</i> | <i>Zero</i> | |
| 1 | 275 | 31 | 15 | 46 | 15 | 27 | 29 | 32 |
| 2 | 285 | 24 | 9 | 33 | 7 | 19 | 13 | 16 |
| 3 | 291 | 40 | 13 | 53 | 2 | 33 | 26 | 33 |
| 4 | 281 | 25 | 8 | 33 | 10 | 21 | 10 | 17 |
| 5 | 260 | 22 | 16 | 38 | 27 | 14 | 32 | 24 |
| 6 | 275 | 21 | 10 | 31 | 14 | 12 | 17 | 12 |
| 7 | 275 | 26 | 6 | 32 | 16 | 22 | 6 | 14 |
| 8 | 260 | 18 | 9 | 27 | 30 | 9 | 14 | 7 |
| 9 | 242 | 16 | 6 | 32 | 33 | 6 | 7 | 15 |
| 10 | 271 | 31 | 11 | 42 | 20 | 28 | 20 | 27 |
| 11 | 261 | 23 | 8 | 31 | 26 | 17 | 11 | 13 |
| 12 | 287 | 22 | 7 | 29 | 4 | 15 | 8 | 9 |
| 13 | 270 | 32 | 13 | 45 | 22 | 29 | 27 | 30 |
| 14 | 263 | 26 | 4 | 30 | 24 | 23 | 3 | 10 |
| 15 | 256 | 8 | 10 | 18 | 28 | 4 | 18 | 4 |
| 16 | 273 | 14 | 9 | 23 | 18 | 5 | 15 | 6 |
| 17 | 250 | 16 | 4 | 20 | 31 | 7 | 4 | 5 |
| 18 | 251 | 19 | 19 | 38 | 29 | 10 | 33 | 23 |
| 19 | 271 | 21 | 7 | 28 | 20 | 13 | 9 | 8 |
| 20 | 262 | 6 | 5 | 11 | 25 | 3 | 5 | 3 |
| 21 | 282 | 23 | 12 | 35 | 9 | 18 | 23 | 20 |
| 22 | 285 | 32 | 12 | 44 | 6 | 30 | 24 | 29 |
| 23 | 271 | 22 | 12 | 34 | 20 | 16 | 25 | 18 |
| 24 | 277 | 5 | 3 | 8 | 12 | 2 | 2 | 2 |
| 25 | 291 | 32 | 13 | 45 | 3 | 31 | 28 | 31 |
| 26 | 295 | 33 | 10 | 43 | 1 | 32 | 19 | 28 |
| 27 | 285 | 28 | 9 | 37 | 8 | 25 | 16 | 22 |
| 28 | 281 | 24 | 11 | 35 | 11 | 20 | 21 | 21 |
| 29 | 244 | 4 | 2 | 6 | 32 | 1 | 1 | 1 |
| 30 | 264 | 30 | 8 | 38 | 23 | 12 | 12 | 24 |
| 31 | 276 | 19 | 15 | 34 | 13 | 30 | 30 | 19 |
| 32 | 286 | 27 | 11 | 38 | 5 | 22 | 22 | 25 |
| 33 | 274 | 16 | 15 | 31 | 17 | 31 | 31 | 11 |

TABLE 8

(Showing the total values of the plus and the minus scores for each individual, with the relative rank in each. No zero scores are included, since their value is obviously zero in any case.)

| <i>Individual No.</i> | <i>Value of Plus Scores</i> | <i>Value of Minus Scores</i> | <i>Order of Rank</i> | |
|---------------------------|---------------------------------|----------------------------------|----------------------|---------------------|
| | | | <i>Plus Scores</i> | <i>Minus Scores</i> |
| 1 | 441 | 70 | 6 | 24 |
| 2 | 426 | 55 | 16 | 15 |
| 3 | 416 | 105 | 21 | 33 |
| 4 | 449 | 70 | 4 | 25 |
| 5 | 433 | 55 | 11 | 16 |
| 6 | 425 | 56 | 18 | 17 |
| 7 | 440 | 30 | 8 | 5 |
| 8 | 407 | 18 | 25 | 4 |
| 9 | 393 | 40 | 28 | 9 |
| 10 | 451 | 83 | 3 | 29 |
| 11 | 409 | 58 | 24 | 19 |
| 12 | 427 | 60 | 13 | 21 |
| 13 | 436 | 75 | 10 | 26 |
| 14 | 424 | 59 | 19 | 20 |
| 15 | 392 | 38 | 29 | 7 |
| 16 | 410 | 39 | 23 | 8 |
| 17 | 390 | 32 | 30 | 6 |
| 18 | 396 | 45 | 27 | 11 |
| 19 | 429 | 54 | 12 | 14 |
| 20 | 379 | 14 | 33 | 3 |
| 21 | 426 | 57 | 16 | 18 |
| 22 | 443 | 86 | 5 | 32 |
| 23 | 416 | 53 | 22 | 13 |
| 24 | 387 | 13 | 31 | 2 |
| 25 | 454 | 83 | 2 | 30 |
| 26 | 456 | 84 | 1 | 31 |
| 27 | 438 | 69 | 9 | 23 |
| 28 | 427 | 61 | 14 | 22 |
| 29 | 387 | 10 | 32 | 1 |
| 30 | 422 | 77 | 20 | 28 |
| 31 | 426 | 45 | 16 | 12 |
| 32 | 441 | 75 | 7 | 27 |
| 33 | 397 | 42 | 26 | 10 |

(Note: In tables 7 and 8 the term "plus" scores includes the correct scores in all parts of the Thorndike examination, both in those parts where no minus and zero scores are possible as well as in those where minus and zero scores might have been made.)

From the preceding tables we may obtain the data for the following correlations, all of which have been computed by the "rank-difference" method and the use of the Spearman formula.

TABLE 9
SUMMARY OF CORRELATIONS

| <i>Correlation of</i> | |
|--|--------|
| 1. Total number of plus scores and scholastic index | .467 |
| 2. Total number of minus scores and scholastic index | .344 |
| 3. Total number of zero scores and scholastic index | .303 |
| 4. Total number of minus and zero scores combined and scholastic index | .271 |
| 5. Total value of plus scores and scholastic index | — .457 |
| 6. Total value of minus scores and scholastic index | .230 |
| 7. Intelligence index and scholastic index | — .271 |
| 8. Intelligence score and scholastic index | — .126 |

The Significance of Negative Scores

Although no general statement can be made regarding any of the results of the preliminary study because of the small number of cases involved, nevertheless it will be seen from an inspection of the table of correlations above that the significance of the minus scores is decidedly marked. In fact, the minus scores are the only ones which give a *plus* correlation with the scholastic performance as regards *both* their number and their value. The *number* of negative scores has a correlation of .344 with the scholastic performance and the *value* of these same scores shows a correlation of .230 with scholastic performance. It was thought worth while, therefore, to carry this phase of the matter further by treating the negative scores from a slightly different point of view.

An inspection of the intelligence examination papers of the 33 individuals showed that most of the minus scores occurred in the following tests:

- Part II, test 7 (Mechanical Information)
- test 8 (True-False—Hard)
- Part III, test 2 (Sentence Completion)

The mechanical information test is made up of rather difficult items, which demand a certain degree of technical knowledge before they can be answered correctly. Hence, the average person with only 4 minutes to answer 10 questions prefers to guess at two or three of them instead of leaving them all blank. The questions are so phrased that a guess

usually turns out to be wrong, because of the highly specialized information necessary for correct answers; hence the frequency of the minus scores here.

In Part II, test 8, there is a list of 60 statements to be marked T or F accordingly as they may be true or false. The number is so large that the subject is almost "lured on" to take chances, though he is usually cautious enough not to allow the number of his guesses to exceed the number of answers of which he is reasonably sure. The time allowed for this test is 13 minutes, and consequently there is usually ample opportunity for taking chances.

The sentence completions of Part III, test 2, are all quite difficult. The sentences have no immediate context from which the subject may judge of the correctness of his answers, and in many instances several words may be supplied in the same blank space and the sentence will still apparently "make sense." Although 20 minutes is allowed for this test, many items are likely to be wrong because of the subject's lack of any criterion of correctness except his own information.

It may be said, therefore, that these three tests seem to have special significance as far as minus scores are concerned, though the extent of this value is yet to be determined.

Outside of the plus cores, which, of course, form the most important part of an individual's final score, the correlations obtained would seem to indicate that the minus and the zero scores offer the most promising field for investigation in a more extended study of performance on the tests. Whether or not these types of scores possess any real importance will be the subject to be dealt with in the succeeding chapter.

As an illustration of the difference in scholarship between individuals showing a large number of minus scores and those showing a small number the following may be mentioned:

The entire group of 33 individuals was divided into two smaller groups of 16 and 17 respectively on the basis of the actual number of minus scores made by each person. For Group I the range of minus scores was from 4 to 23, with an average of 15.6; for Group II the range was from 23 to 40 with an average of 31.7, or more than twice as many as the average for Group I. Between the average intelligence

scores of the two groups there was a difference of only 1.2, and for all practical purposes this difference is a negligible one. The two groups may, therefore, be considered as having approximately the same intelligence. The average intelligence index for Group I was 64.8, with an average scholastic index of 55.6 (nearly D+ on the letter scale), while for Group II the average intelligence index was 2.8 points higher, or 67.6, but for this group the average scholastic index was only 47.0 (nearly D- on the letter scale), i.e. 8.6 points lower than that of Group I. If similar results were obtained for a considerable number of cases, it would seem to show that the number of minus scores made by an individual is of considerable value in predicting his probable scholastic performance. In other words, the larger the number of minus scores, the lower the scholastic index of the individual is likely to be (other things being equal). This phase of the subject is dealt with more fully in the next chapter.

The results of the comparison indicated above are summarized in the table below.

TABLE 10

(Showing the comparison between two groups arranged on the basis of the number of minus scores made by each in the Thorndike intelligence examination.)

| | <i>Group I</i> | <i>Group II</i> |
|--------------------------------|----------------|-----------------|
| No. of individuals | 16 | 17 |
| Range of Minus Scores | 4-22 | 23-40 |
| Average Number of Minus Scores | 15.6 | 31.7 |
| Average Intelligence Score | 74.4 | 73.2 |
| Average Intelligence Index | 64.8 | 67.6 |
| Average Scholastic Index | 55.6 (= D+) | 47.0 (= D-) |

(*Note:* In this part of the study the figures are given on a basis of 100 instead of 1 as previously. This is for the purpose of making the differences between the two groups more apparent than they otherwise would be.)

Summary

The results of the preliminary study would seem to indicate that both the number and the value of the minus scores, as well as the number of zero scores, possess more or less significance when taken in their relation to intelligence test performance, and it is entirely possible that they might show even greater importance in a larger group of individuals. If the minus and zero scores combined be taken as an index of the "willingness" or "unwillingness" to "take a chance," or of "caution" and "rashness" in the case of the individuals tested, it is quite obvious that what one does on an "intelli-

gence examination" (so-called) is the product of something more than strictly intellectual factors. There must be character traits called into play as well, and these leave behind them more or less evidence of their presence. In the following chapter the "caution" factor, as a trait of character appearing in intelligence test performance, has been made the study of a more detailed investigation on the basis of the results obtained in this preliminary survey of the matter.

CHAPTER IV

A STUDY OF THE "CAUTION" FACTOR AND ITS IMPORTANCE IN INTELLIGENCE TEST PERFORMANCE

As previously pointed out, a preliminary study of the various kinds of scores given in the Thorndike intelligence examination led to the conclusion that much more significance is to be attached to the wrong answers made by an individual taking the examination than would appear at first sight. Heretofore the plus scores have been most emphasized in all examinations of this character, and present practice in scoring leads to the utter disregard of minus scores in most cases. Where chance seems to play a large part (as in "plus-minus" or "true-false" tests) the common method of computing the score is to subtract the number wrong from the number right.

Professor Thorndike seems to have been the first to recognize that this formula did not completely evaluate the wrong answers, and he accordingly provides a more elaborate method of scoring for his intelligence examination together with a variety of situations which have been already described (see Chapter III). Other devisers of tests have yet to follow this example, and, for the most part, the question of the scoring and interpretation of wrong answers in intelligence examinations remains as yet unanswered. Certain it is, however, that these reactions of an individual possess as much significance in their way as do the answers which are scored correct. The difficulty lies in finding the objective means for placing an estimate on these various types of response.

In making the present study the writer lays no claim to originality of method or of interpretation. The attempt has been made merely to substantiate the hypothesis above mentioned and to discover at least some of the ways in which wrong answers on intelligence tests may be evaluated. The question of the further interpretation of correct answers and of items not tried has not been undertaken, but it is hoped that these also will be studied in the not too distant future by others who are interested in the matter.

Character and the "Caution" Factor

Ordinarily the terms "cautious" and "rash" are used to designate persons of more or less opposite types. If we assume the presence of "caution" as a trait of human personality, we may say that a person, in whom this factor is dominant, is of the "cautious," "careful," or "conservative" type, while one who tends to the opposite extreme is commonly called "rash" or "careless." There seems to be no reason to believe that these are not entirely valid distinctions, and, while they differ from each other rather in degree than in kind, they nevertheless represent more or less definite concepts in each individual mind. It may also be added that these concepts are usually thought of as belonging to the domain of character rather than to that of intelligence.

Granted the existence of such a trait as we have described, we can, at least from an abstract viewpoint, treat it quantitatively by measuring its presence or absence in a given individual by the use of a percentage scale. On this scale the 100 per cent. point may be taken to represent that point at which would be placed that member of a given group showing the greatest tendency to be "cautious," i.e. the most conservative member of the group. The most "rash" (or least conservative) individual would then be given a rating of zero, and the remaining members of the group distributed in their proper order between these two extremes. With such a distribution, those persons at the upper end of the scale would be designated as "cautious" or "careful," or at least fairly so, while those at the lower end would comprise the individuals whom we ordinarily know as "rash." It is altogether probable that, if a large enough group were taken as a sample, our distribution would follow that of the "normal curve." The majority of the group would then be expected to fall within the middle range of the scale, i.e. between the 25 per cent. and the 75 per cent. points, and to be more nearly typical of the average person, who is, in the long run, neither over-cautious nor excessively rash.

Our present limited means for the investigation of character traits on a scientific basis make it almost an impossibility to undertake a further analysis of the trait which we have just described. It may or may not be related to intelligence, though the former is most probably the case, since

there are times when it is necessary for us to know, not only *when*, but *how* to be cautious. Again, the caution factor may be complex or it may be comparatively simple. It may form a part of a "hierarchy"⁴⁸ of traits, or it may be comparatively isolated. In any event the "caution factor" seems to be the simplest term we can apply to it, and, though this falls somewhat short of any adequate description of the trait or its implications, it seems advisable in the present study to use this term for want of a better one.

There is probably not much difference between the "caution factor," as used here, and "sagacity," which James⁴⁹ calls the "perception of essence," "the ability to extract characters—not *any* characters, but the right character." This he distinguishes from learning, which he calls "the ability to recall promptly consequences, concomitants, or implications." Following James, Hollingworth⁵⁰ in speaking of stimulus and response says:

"If the detail which occurs is what we commonly call a significant part (of the stimulus), the response is a useful perceptual reaction. The more irrelevant the detail responded to, the more lacking in sagacity, and, hence, the more psychoneurotic is the individual to be considered." (p. 21.) * * *

"Sagacity is, then the ability to comprehend properly the part in its relation to the whole and to discriminate, out of a whole, the appropriate, relevant, or significant details. Failure in sagacity will thus imply a disposition to react to a present total situation by singling out *some* detail of it and reacting to this detail by *some* total reaction previously associated with a whole in which the detail figured as an item. This is the mechanism of the psychoneuroses." (ibidem.)

One more question needs to be dealt with briefly, namely, "Under what circumstances does this factor, if present in an individual, make its appearance?" No well-defined situation may be described in answer to this question and regarded as a typical one. Generally speaking, lack of knowledge, either of facts or of method of procedure, coupled with other elements which make the situation an important one, such as the necessity for speed, the urgency of the occasion, and the character of the probable outcome, furnishes a sufficient stimulus for the activity of the caution factor. It will be observed, moreover, that a situation similar to the one just

⁴⁸Hart, B. and Spearman, C., op. cit.

⁴⁹James, William, "Principles of Psychology." New York, 1890, Vol. II, p. 331.

⁵⁰Hollingworth, H. L., "Psychology of Functional Neuroses." New York, 1920.

described tends to have exactly the opposite effect on the "careless" or "rash" individual, who either lacks the caution trait or successfully inhibits its action—it is difficult to say which of the two actually occurs. If there is such a thing as "resistance to the tendency to be cautious," this would operate parallel to the caution factor itself, both being mutually inhibitory, as two pairs of muscles, e.g. the flexors and the extensors, in the human body.

It is, of course, quite possible that the caution factor is present in situations which are not at all critical. Our problem is not so much the determining of the nature of the stimulus which arouses it, but to study its effects upon the performance of an individual in whom it is present as contrasted with that of one in whom it is either lacking or for the time being inhibited by some other factor or group of factors.

Description of the Groups Studied

In order to make the investigation as comprehensive as possible it was thought best to select for study three groups differing considerably in respect to environment and previous training. All of the members of these groups had previously been tested by the use of one or more of the standard intelligence tests, and the test papers were in every case carefully studied for evidences of the presence or absence of the caution factor in the individual's performance. In Groups I and II the attempt was made to study the effect of this factor on scholarship, while in the case of Group III the methods and results obtained from the investigation of the other two groups were applied to a number of widely different types of individuals.

Group I consisted of 375 students in Columbia College, who were admitted in September, 1919, and had remained for at least one semester in residence. These students were a part of a still larger group of 505 candidates for admission, who took the Thorndike intelligence examination at the same time. Some, however, failed to attain the required intelligence rating and others could not be included in the investigation because of incomplete scholastic records or unavailability of their intelligence examination papers. No records of women students were studied and the ages of the individuals in the group were those of the average entering class in most colleges and universities.

Group II was composed of 193 children—147 boys and 46 girls—from Public School No. 192, New York City. This school is operated in connection with the Hebrew Orphan Asylum and is attended only by the children in that institution. The individuals studied ranged in age from 10 to 14 years and had all been given the Stanford revision of the Binet-Simon test. Some of them had also been tested with the Otis group test. The results of these tests were studied in relation to both the scholastic performance and the conduct of the children composing the group.

Group III was made up of 166 men who passed through the United States Army General Hospital No. 30, at Plattsburg Barracks, New York, during the years 1918 and 1919⁵¹. These were all abnormal cases, ranging in chronological age from 18 to 41, and most of them had been in active service with the American army in Europe during the World War. On the basis of medical diagnosis, these individuals may be classified as follows:

| | |
|---|-----|
| Psychoneurotics (not further specified) | 68 |
| Epileptics | 32 |
| Hysterics | 21 |
| Psychoneurotics (Syphilitic) | 18 |
| Mentally Deficient | 17 |
| Psychasthenics | 5 |
| Exhaustion Neurotics | 5 |
| Total | 166 |

The last four groups include all the available cases in these classifications, and hence the small number included in them. All of these individuals were required to take certain tests, of which the Trabue completion test was selected for study in the present investigation. The introduction of this group was for the purpose of testing the application of certain facts derived from the study of Groups I and II, and hence it was dealt with on a somewhat different basis from that used in the other groups.

METHOD AND PROCEDURE

In the case of all these groups, the wrong answers made on the intelligence examination were taken as indicative of the presence or absence of the caution factor. For, as has already

⁵¹The data for this group were made accessible to the writer by the kindness of Professor H. L. Hollingworth, Barnard College, Columbia University.

been pointed out (see Chapter III), the giving of an incorrect answer to any question, whatever else it may indicate, shows that the individual did not know the right answer or was unable to recall it at the moment, and yet he gave an answer of some sort, which in this case proved to be wrong. When we consider the fact that many of the answers, which were scored right, must have likewise involved the element of guessing, the reasonableness of our assumption regarding the interpretation of the wrong answers becomes more evident. For, on the mathematical theory of chance, in a long series of guesses, just as many answers are likely to be correct as incorrect. Thus, the full significance of the caution factor and the part which it plays in any given case cannot be arrived at except by an additional investigation of the number of guesses in the correct, as well as in the incorrect, answers. Because of our present very limited means for this purpose, the study of this phase of the matter is necessarily excluded.

In substantiation of the above observation on the presence of guesses in right answers, may be mentioned the work of Fullerton and Cattell⁵², who compelled their subjects to guess in deciding which was the heavier of two weights when the difference was so slight as to be imperceptible by ordinary observational processes. They found that, under these conditions, the subject achieved an average of 71 per cent of right answers instead of the conventional 50 per cent. Similar results have been found by other investigators⁵³. Hence, a comprehensive study of the caution factor, taking into account caution as displayed in the right as well as the wrong answers, would probably serve to emphasize the results which we have here obtained from an investigation of caution as connected with the wrong answers alone.

If a large number of wrong answers on the usual intelligence examination may be taken as indicative of the absence of caution, this is even more true of the minus and cross scores on the Thorndike intelligence examination. For those individuals, who took the latter test, only those parts were studied

⁵²Fullerton, G. S. and Cattell, J. McK., "On the Perception of Small Differences." Univ. of Pa. Publications, Phil. Series, No. 2, May, 1892, p. 127.

⁵³Larson, E. L., in an unpublished investigation made at Teachers College found approximately the same results.

where the subject was warned in the test directions that a wrong answer would count off from his score⁵⁴. It will be seen, therefore, that in six of the tests in Part II and all of those in Part III any guessing, which is indulged in, must be more or less deliberate and may be taken as satisfactory evidence that the caution factor was absent in that particular case, in fact, even more so than under the usual test conditions.

It may be objected that, in many instances, the person taking the examination gives answers which he believes to be right. Such is doubtless often the case, but the person in whom the caution factor is operating at its maximum would most probably refuse to write down any answer of which he was not absolutely sure. Lack of the knowledge that he is right, even when he has a high degree of confidence in his answer, would tend to make the extremely cautious individual omit the item altogether, while a less cautious person would hazard a guess in many cases. It has, of course, been found that the greater percentage of correct answers normally accompanies the higher degrees of confidence⁵⁵, but this rule is not without its exceptions.

It will be recalled that Professor Thorndike, in the parts of his intelligence examination used for this study, provides for the giving of zero, as well as of minus, scores. Any answer is scored zero when it is incorrect and yet not in the class of foolish and irrelevant answers. Since a zero answer is for all practical purposes a wrong answer, it was thought entirely proper to estimate the presence or absence of the caution factor on the basis of the total number of both minus and zero scores combined made by any individual in those parts of the Thorndike intelligence examination which were included in the study. Thus, if a person made 15 minus scores and 7 zero scores in the examination, he was credited with 22 wrong answers, and this figure was taken as the "caution index" for

⁵⁴For a detailed description of these parts of the Thorndike intelligence examination, the reader is referred to Chapter III.

⁵⁵For further information on this point, see Fullerton, G. S. and Cattell, J. McK., *op. cit.*; Martin, L. J. and Mueller, G. E., "*Zur Analyse der Unterschiedsempfindlichkeit*," Leipzig, 1899; Williamson, G. F., "Individual Differences in Belief Measured and Expressed by Degrees of Confidence," *Journ. of Phil., Psych., and Sci. Methods*, 1915, 12, 127-137; Strong, E. K., Jr., "The Effect of Length of Series upon Recognition Memory," *Psych. Rev.*, 1912, 19, 447-462.

the members of Group I without any further attempt at analysis.

For the individuals of Group II, the performance on the Binet test was studied for evidence of the operation of the caution factor. It was found that the vocabulary test alone proved satisfactory for this purpose, as it was the only test which was actually performed by every one of the 193 children tested. It was also found difficult to make any estimate as to the caution factor in the answers for many of the other tests because of the wide latitude allowable in some places (e.g., in such tests as the ball in the field, drawing a diamond, etc.). Therefore, for the sake of uniformity and for other reasons, the vocabulary test alone was included in the investigation. Here, since there were specified limits for the different age levels, the number of wrong answers had to be considered in relation to the total number of words given to the child to define. Some children were taken through the entire list, others were given as few as 10 or 15 words. It is obvious from these facts that the only way of comparing the various individuals for the caution factor is in terms of the percentage of wrong answers out of the total number possible. Thus, if a child were asked to define 20 words, with a total of 10 correct, 5 wrong, and 5 not tried, his caution index was determined as 25 (i.e., he made a total of 25 per cent wrong responses). Another individual, however, making only 5 incorrect responses out of a total of 50 possibilities, would be credited with a caution index of 10. By this method, of course, the person with the smaller index is regarded as having shown the larger degree of caution and vice versa.

Of the children in Group II, there were 88 who also took the Otis group test. In these cases, the caution index was taken as equal to the total number of wrong answers made by the child, since the number of possibilities was the same in every case. Reducing these results to a percentage basis would not have changed the final outcome in any way.

For Group III, the Trabue completion test was studied for evidences of the caution factor. Both of the preceding groups were fairly homogeneous and showed mental ages such as would put them all in the "normal" class. But in the third group, composed of men who showed various kinds of mental abnormalities, the range of the mental ages and the I. Q.'s was too great to permit of the treatment of the group as a

homogeneous one. Furthermore, the variety and amount of material to be found in the Trabue completion test made it too limited in scope and prevented it from proving as satisfactory for purposes of the present study as might otherwise have been the case. But no other usable data were available, and the results obtained were all the more remarkable, confirming, as they do, the facts derived from the study of Groups I and II. It was thought best, therefore, all things considered, to represent the caution index in this last group in terms of the percentage of wrong completions as compared with the number attempted⁵⁶ and not with the entire 24 items of which the test is composed. Thus, an individual, attempting 10 completions with 8 right and 2 wrong, would receive an index of 20, etc. Here, also, the larger index indicates less caution, as in the case of the Binet test for Group II.

By way of summary, it may be said that, for subjects taking the Thorndike test and the Otis group test, the caution index was taken as equal to the number of wrong answers without further treatment; and for those taking the Binet vocabulary test and the Trabue completion test, the index was expressed in terms of the following formula:

$$\text{Caution index} = \frac{\text{No. items wrong}}{\text{No. items possible}}$$

We are now ready to proceed to a consideration of the method used for determining the scholastic index of the groups studied. There were no school records available for Group III, and, hence, there are no scholastic indexes for these subjects. For Group I, the index was computed by transmuting the letter grades—A, B, C, D, and F—into their numerical equivalents on a scale ranging from 15 to 1. A full account of this procedure has already been given. (See Chapter III and Table 5.)

⁵⁶I have used the word "attempted" here to express an idea for which a better expression seems entirely lacking. I hold that it is quite possible for one to "attempt" or "essay" a task mentally without writing down on paper the result of such an "attempt" or giving any other very objective indication of it. In many cases, in Group III, an individual wrote no answer to some of the items on the Trabue test, and yet it is quite possible that he put forth considerable mental effort in trying to discover the correct completions. All we can do in such a case, however, is to take the last item, for which there is a written answer, as the limit of the individual's endeavor and estimate the overtly wrong answers as a percentage of this limit. A similar observation may be made with reference to the Binet vocabulary test.

The scholastic performance of the children in Public School No. 192 is recorded by letters ranging from A to D. Only one letter is entered on the permanent records for each child, and this represents that child's general average in his studies for an entire half-year. If he is deficient in any subjects, the names of these are entered in a space provided for this purpose. Finally, the pupil is also given a term mark on conduct, likewise indicated by one of the letters, A, B, C, and D. For both scholarship and conduct, any grade above C indicates passing, while both C and D are unsatisfactory. Strangely enough, a B grade may represent anywhere from 60 to 90 on a percentage scale, and this fact made the construction of a transmutation table exceedingly difficult. However, after consultation with several of the school officials, the letter grades were assigned a numerical equivalent on the basis of 10, which represents, as nearly as possible, the actual value of that grade in percentage terms. The final results are shown in the table below.

TABLE 11

(Showing the numerical equivalent for each letter grade as used in rating the scholastic performance and conduct of the individuals in Group II.)

| <i>Letter Grade</i> | <i>With Deficiencies</i> | <i>Equivalent</i> | <i>Without Deficiencies</i> |
|---------------------|--------------------------|-------------------|-----------------------------|
| A | 9 | | 8.5 |
| A— | 8.5 | | 8 |
| B+ | 8 | | 7.5 |
| B | 7 | | 6.5 |
| B— | 6 | | 5.5 |
| C | 5 | | 4.5 |
| D | 4 | | 3.5 |

Except in very few instances, only the grades obtained in Public School No. 192 were used in computing the scholastic index for this group, in order that the conditions of the experiment might be kept as nearly the same as possible for all individuals. The half dozen exceptions to this rule were made in cases where a pupil had been in the school for two or three terms only, and in such instances it was necessary to add several grades from the school last attended in order to obtain a reliable index.

After transmuting the letter grades into their numerical equivalents, the total for each child was obtained and divided by the number of terms during which he had been in attendance at the school. In this way, the scholastic index was made to represent the pupil's average performance during

the time that he was in school. The same may be said of the Columbia College students, and a simple inspection of the scholastic index, in either case, tells at a glance the general calibre of the individual's school work. For example, a Columbia student, whose scholastic index is 10.17, is a B man, and a pupil in Public School No. 192, who has an index of 7.34, is a B pupil.

The intelligence rating for each of the three groups was represented as follows:

For Group I, the total score obtained on the Thorndike intelligence examination.

For Group II, the I. Q. obtained by means of the Stanford revision of the Binet-Simon test.

For Group III, the I. Q. and M. A. as obtained from the "team of tests" administered by the army psychologists⁵⁷.

In the case of Group II, a conduct index was found for each

TABLE 12

(Showing samples of the data obtained for Group I and the method of classification.)

| <i>Individual No.</i> | <i>Schol. Index</i> | <i>Intell. Score</i> | <i>No. Minus Scores</i> | <i>No. Zero Scores</i> | <i>Caution Index</i> |
|---------------------------|-------------------------|--------------------------|-----------------------------|----------------------------|--------------------------|
| 1 | 7.88 | 75.0 | 31 | 15 | 46 |
| 2 | 5.42 | 74.6 | 24 | 9 | 33 |
| 3 | 7.01 | 71.2 | 40 | 13 | 53 |
| 4 | 4.11 | 75.8 | 25 | 8 | 33 |
| 5 | 7.54 | 75.8 | 22 | 16 | 38 |
| 6 | 6.96 | 82.0 | 21 | 10 | 31 |
| 7 | 4.94 | 88.4 | 26 | 6 | 32 |
| 8 | 6.97 | 78.6 | 18 | 9 | 27 |
| 9 | 11.12 | 88.2 | 16 | 6 | 22 |
| 10 | 7.84 | 88.2 | 31 | 11 | 42 |
| 11 | 9.54 | 110.8 | 23 | 8 | 31 |
| 12 | 9.53 | 78.0 | 22 | 7 | 29 |
| 13 | 9.50 | 77.6 | 32 | 13 | 45 |
| 14 | 8.42 | 81.2 | 26 | 4 | 30 |
| 15 | 10.41 | 77.2 | 8 | 10 | 18 |
| 16 | 5.93 | 91.4 | 14 | 9 | 23 |
| 17 | 7.13 | 97.0 | 16 | 4 | 20 |
| 18 | 9.30 | 82.0 | 19 | 19 | 38 |
| 19 | 9.42 | 105.0 | 21 | 7 | 28 |
| 20 | 9.92 | 86.4 | 6 | 5 | 11 |

(Note: It should be remembered that the caution index as noted in the last column above is taken as the equivalent of the total of the minus and zero scores combined.)

⁵⁷These tests included the Woodworth-Wells Substitution Test, Naming Opposites Test (Pintner-Pyle-Whipple), Word Building Test (Pintner-Pyle), Memory Span for Digits, Trabue Completion Test (Scale A), and the P-N Inventory (Woodworth Personal Data Blank), as well as the Army Alpha. See Hollingworth, H. L., "Psychology of Functional Neuroses," New York, 1920, pp. 210 ff., and Tendler, A. D., "The Mental Status of Psychoneurotics," Archives of Psych., 1923, No. 60, p. 9.

pupil by the method already described for obtaining the scholastic index, but, of course, no deductions were made in this case for special deficiencies.

Various other data of minor importance were collected, and all information was classified as indicated in the accompanying tables.

TABLE 13

(Showing the method of classification of samples of the data obtained for Group II.)

| <i>Individual No.</i> | <i>Conduct Index</i> | <i>Schol. Index</i> | <i>I. Q.</i> | <i>Caution Index</i> | |
|---------------------------|--------------------------|-------------------------|--------------|----------------------|-------------|
| | | | | <i>Binet</i> | <i>Otis</i> |
| 1 | 8.40 | 5.75 | 96 | 12.5 | .. |
| 2 | 8.33 | 7.67 | 82 | 9.9 | 52 |
| 3 | 8.95 | 7.50 | 102 | 23.5 | .. |
| 4 | 8.75 | 8.00 | 120 | 16.7 | .. |
| 5 | 9.00 | 6.33 | 98 | 10.0 | .. |
| 6 | 7.88 | 7.63 | 103 | 17.5 | 94 |
| 7 | 8.17 | 7.67 | 106 | 20.0 | .. |
| 8 | 7.88 | 6.44 | 99 | 15.0 | .. |
| 9 | 8.00 | 7.44 | 81 | 19.2 | 65 |
| 10 | 8.00 | 6.75 | 70 | 13.7 | .. |
| 11 | 7.25 | 5.56 | 71 | 12.5 | 32 |
| 12 | 8.00 | 7.13 | 90 | 15.0 | .. |
| 13 | 8.33 | 7.00 | 81 | 35.7 | .. |
| 14 | 8.57 | 6.93 | 102 | 20.0 | .. |
| 15 | 8.00 | 7.60 | 110 | 15.0 | .. |
| 16 | 7.15 | 6.65 | 83 | 3.3 | 99 |
| 17 | 6.80 | 7.00 | 97 | 10.0 | 64 |
| 18 | 8.83 | 7.42 | 80 | 5.0 | .. |
| 19 | 7.44 | 7.22 | 104 | 16.0 | .. |
| 20 | 8.67 | 6.58 | 85 | 14.0 | .. |

(Note: Where no figures are given for the caution factor on the Otis test it is to be understood that the individual in question did not take this test.)

TABLE 14

(Showing samples and method of classifying data for Group III.)

| <i>Individual No.</i> | <i>Caution Index</i> | <i>C. A.</i> | <i>M. A.</i> | <i>I. Q.</i> | <i>Classification</i> |
|---------------------------|--------------------------|--------------|--------------|--------------|-----------------------|
| 1 | 43 | 25 | 18 | 112 | Psychoneurotic |
| 2 | 22 | 18 | 11:5 | 72 | " |
| 3 | 50 | 29 | 13 | 81 | " |
| 4 | 47 | 27 | 9 | 75 | " |
| 5 | 37 | 27 | 8 | 50 | " |
| 6 | 0 | 22 | 8 | 81 | " |
| 7 | 18 | 28 | 13 | 81 | " |
| 8 | 35 | 21 | 13 | 44 | Epileptic |
| 9 | 12 | 23 | 18 | 112 | " |
| 10 | 13 | 20 | 16 | 87 | " |
| 11 | 17 | 26 | 12:6 | 59 | " |
| 12 | 22 | 29 | 7:1 | 106 | " |
| 13 | 0 | 36 | 18 | 81 | Psychasthenic |
| 14 | 17 | 19 | 11:6 | 72 | " |
| 15 | 15 | 29 | 13 | 50 | " |
| 16 | 40 | 25 | 14:1 | 62 | " |
| 17 | 5 | 30 | 9:6 | 82 | Exhaustion Neur. |
| 18 | 8 | 25 | 17 | 69 | " |
| 19 | 12 | 28 | 13 | 94 | " |
| 20 | 18 | 26 | 11:5 | 103 | " |

CHAPTER V

SOME RESULTS OF THE STUDY

Discussion of Results

As a prerequisite to the making of comparisons between the various groups and of interpreting the data obtained in the course of the study, considerable statistical treatment of the material in hand was necessary. In the main, this treatment consisted of:

(1) Finding correlations between factors occurring in individuals included within the same group.

(2) Obtaining partial correlations of the most important factors studied in Groups I and II, these being the caution factor, the scholastic performance, and the intelligence rating.

(3) From the above, getting a regression equation from which the probable scholastic performance of an individual might be predicted, on the basis of the other two variables, i.e., the caution factor and the intelligence score (or I. Q.).

These three steps may be discussed briefly in order.

(1) For the simple correlation between two factors, the Pearson "product-moment" formula was used in every case except in the preliminary study, where, as previously noted, Spearman's "rank-difference" formula was employed. In order to reduce the number of errors to a minimum, the standard tables and the computing machine were used for all but the simplest calculations. These correlations are included in the summary table below.

(2) For the partial correlations only two groups were considered, namely, Groups I and II. Three variables were used—the caution index, scholastic index, and intelligence score (Group I), or I. Q. (Group II). Each variable was eliminated or "partialled out" in turn. These results are also given in the table following.

(3) The usual procedure was followed in finding a regression equation from which the probable scholastic performance of a given individual might be predicted on the basis of his caution index and his intelligence score (or I. Q.). This equation was determined for scholarship only, as it has no

practical value for the prediction of the other variables. The equation for each group is included in the table below.

For Group III, the only correlations practicable were those between the caution factor and the M. A., on the one hand, and between the caution factor and the I. Q. on the other. There is a singular coincidence in the case of the results obtained here, although, for the second correlation, the number of individuals was only 127 on account of the incompleteness of the available records. The correlations are as follows:

Between caution index and M. A., $r = .60 \pm .03$ ($N = 165$)
 Between caution index and I. Q., $r = .61 \pm .04$ ($N = 127$)

An interesting comparison might also be made between the various smaller groups comprising Group III. Because of the small number of individuals in some of these sub-groups, no extensive conclusions may be drawn, but in Table 16 are presented the range and the average for each sub-group in

TABLE 15

| SUMMARY OF CORRELATIONS | | | |
|--|--|----------------|-----------------|
| <i>Between</i> | | <i>Group I</i> | <i>Group II</i> |
| 1. Scholastic index and caution index | | .27±.03 | .15±.05 |
| 2. Scholastic index and intelligence score | | .45±.03 | .40±.04 |
| 3. Intelligence score and caution factor | | .40±.03 | .43±.04 |
| 4. Scholastic index and caution factor with intelligence score excluded | | .11±.03 | -.02±.05 |
| 5. Intelligence score and caution factor with scholastic index excluded | | .22±.03 | .41±.04 |
| 6. Scholastic index and intelligence score with caution index excluded | | .39±.03 | .38±.04 |
| 7. Caution factor and time required for Parts II and III of the Thorndike intelligence examination ($N = 132$) | | .09±.06 | |
| 8. Scholastic index and no. minus scores | | .24±.03 | |
| 9. Scholastic index and no. plus scores | | .10±.04 | |
| 10. Scholastic index and value of minus scores | | -.14±.04 | |
| 11. Scholastic index and value of plus scores | | .22±.03 | |
| 12. No. of probations and caution index ($N = 40$) | | .71±.05 | |
| 13. Conduct index and caution factor | | | .07±.05 |
| 14. Scholastic index and caution index (Otis) ($N = 88$) | | | .49±.05 |

NOTE 1. All correlations and P. E.'s were carried to two decimal places only, and this accounts for the apparent lack of variation of the P. E.'s in some of the cases listed above.

NOTE 2. On the assumption that, in "true-false" tests, the chance element operates to make half the guesses right and half of them wrong, the number of wrong scores was doubled for Part II, test 8, in the Thorndike intelligence examination and the experiment was tried of correlating the changed caution index with the scholastic index. The result showed a correlation of $.26 \pm .03$ as compared with the original $.27 \pm .03$ (see above), thus making no appreciable difference in the figures already obtained.

respect to M. A., I. Q., and the caution index together with the number of individuals included in each classification. The reader's attention should again be called to the fact that a low caution index always indicates the presence of the trait to a high degree, and vice versa.

TABLE 16

(Showing the range and the average of the M. A., I. Q., and caution index for each of the sub-groups included in Group III.)

| Classification | No. of Individuals | M. A. | | I. Q. | | Caution Index | |
|---|-----------------------|--------|-------|--------|------|---------------|------|
| | | Range | Avg. | Range | Avg. | Range | Avg. |
| Psychoneurotics (not further specified) | 68 | 7:1-18 | 12:7 | 44-112 | 77.9 | 0-84 | 17.4 |
| Epileptics | 32 | 8 -18 | 12:11 | 50-113 | 79.9 | 0-77 | 17.6 |
| Hysterics | 21 | 8-17:5 | 12:7 | 58-109 | 83.1 | 0-76 | 17.4 |
| Psychoneurotics (syphilitic) | 18 | 8 -17 | 13:7 | 50-106 | 83.7 | 0-53 | 15.8 |
| Mental Defectives | 17 | 7 -14 | 8:11 | 42-65 | 52.8 | 5-83 | 33.9 |
| Psychasthenics | 5 | 10 -18 | 14:0 | 63-118 | 88.6 | 0-37 | 11.2 |
| Exhaustion Neurotics | 5 | 10 -18 | 13:4 | 62-113 | 83.2 | 0-45 | 14.8 |

SIGNIFICANCE OF RESULTS

For the most part, there is singular agreement between Groups I and II in the matter of correlations. For both groups, the correlation between the scholastic index and the caution index is the lowest, being $.27 \pm .03$ and $.15 \pm .05$, respectively. Between the scholastic index and the intelligence score⁵⁸, a correlation of $.45 \pm .03$ was found for Group I and one of $.40 \pm .04$ for Group II. The same groups show a correlation of $.40 \pm .03$ and $.43 \pm .04$, respectively, between the caution index and the intelligence score. While the correlations are all somewhat low, we may conclude that the caution factor seems to have little influence on an individual's scholastic performance, though it does seem to affect his score on an intelligence test. This is the premise with which we started, and there can be little doubt that the caution factor, as a rule, plays no inconsiderable part in intelligence test performance.

The correlations between the intelligence score and the scholastic index are as good as the average correlations between the same factors obtained by Wood⁵⁹. His highest correlation (.672) was obtained with a somewhat selected group chosen from the individuals included in Group I of

⁵⁸The expression "intelligence score" as used here includes also the I. Q., which was used to indicate the intelligence rating of the members of Group II.

⁵⁹Wood, B. D., op. cit.

this study. It may be said further, that his data for determining the scholastic performance of his group covered a period of two years instead of three, and the increase in the size of the group plus that of the number of scholastic grades included in the present investigation may be regarded as, in some degree, accounting for the lower correlation of $.45 \pm .03$ obtained in this case. Some equally low correlations have been found in other studies⁶⁰. In any event, we may say that the general intelligence of a person, as measured by his I. Q. or his score on the Thorndike examination, is an important factor in his scholastic performance.

As to the partial correlations, the low figures obtained with both groups between the scholastic index and the caution index, with the effect of intelligence eliminated, seems to show that the "cautiousness" or "rashness" of an individual does not affect his school standing. But note that this is true *in the long run*, and it is entirely possible that, since the normal distribution curve may be assumed for the caution factor, the "rashness" which is manifested by a person in one situation may be compensated for by considerable "caution" in another situation. In the correlation mentioned above, where the effect of intelligence was not eliminated, the same general tendency seems to be present.

With the results of schooling ruled out, the two groups show a considerable difference in the effects of the caution factor on the intelligence score. For Group I, the correlation is $.22 \pm .03$, while for Group II, it is $.41 \pm .04$. This difference is probably due to various causes, among which may be especially mentioned the wide variation between the two situations in which the individual is tested. The Thorndike test is administered as a group test and the individual in question must make the decision as to whether he will guess or not. But the Binet test is administered by an examiner, who directly confronts the subject. Hence, the personal equation enters greatly into a situation of this kind. In addi-

⁶⁰See Gordon, E. and Baker, H. J., "Intelligence Tests and Academic Standing," *Journ. of Applied Psych.*, 1920, 4, 361-363. These writers studied the I. Q.'s of 44 students at the University of Michigan as correlated with their scholastic performance by courses. The highest correlation obtained was .55 with several others much lower. In a similar study with 48 college students, Caldwell found a correlation of only .44 between I. Q.'s and scholastic performance. (See Caldwell, H. H., "Adult Tests of the Stanford Revision Applied to College Students," *Journ. of Ed. Psych.*, 1919, 10, 477-487.)

tion, many examiners consistently urge the child to guess, even though he says, "I do not know"; and he is told repeatedly to "try" or "try again," as the case may be. In such instances, therefore, the number of wrong answers would, other things being equal, in all probability be much greater as compared with the number of correct answers or with the total number of items on the test than would be the case under other circumstances.

If, now, we eliminate the effect of the caution factor, the correlations between the scholastic index and the intelligence score are found to be $.39 \pm .03$ and $.38 \pm .04$ for the two groups. Hence, while the correlations in each case are in very close agreement, the two sets of figures do not show a very appreciable difference. This fact would seem to indicate that little would be gained by the elimination of the caution factor from intelligence test performance, at least as far as predicting probable scholarship is concerned.

The other correlations presented in Table 15 possess a less marked significance. For Group I, there seems to be little relation between the speed with which the intelligence examination was taken and the caution factor, i.e., a fast-working individual does not necessarily show any less caution than a slow-working person of the same intelligence.

If we take the number of minus scores alone as indicative of the presence or absence of the caution factor, we get for Group I a correlation of $.24 \pm .03$ with scholastic performance, as contrasted with one of $.27 \pm .03$ when the minus scores are combined with the zero scores to make the caution index. For a large number of cases, either method of determining the caution index would probably be satisfactory.

The correlations in Group I between scholastic performance and the number of plus scores, the value of the plus scores, and the value of the minus scores, taken in turn are all too low to enable us to draw any satisfactory conclusions.

A correlation of $.71 \pm .05$ was obtained for 40 individuals in Group I between the caution index and the actual number of times each was placed on probation during the time in which he was in college. This would tend to show that the "rash" person is more likely to get on probation than the "cautious" one, but the number of cases examined is too small

and the method of treating probations too unsatisfactory to make any such conclusion a valid one⁶¹.

In Group II, a correlation of $.07 \pm .05$ seems to show no relation between conduct and the caution factor in the case of public school children. This is in agreement with the general results for the same group between scholarship and the caution factor, and may probably be explained in the same way (see above).

A correlation of $.49 \pm .05$ for 88 persons in Group II between the caution index, as determined on the basis of the Otis group test, and the scholastic index may be explained by the fact that the number of individuals is too small for general conclusions. A larger group might be expected to reduce this correlation, causing it to conform more with those obtained from the use of the Thorndike and the Binet tests.

The equations as determined for the purpose of predicting the probable scholastic achievement of individuals when their intelligence score and caution index are known are as follows:

For Group I, we have:

$$X_1 = 2.72 + .02X_2 + .06X_3 \quad (P. E. = \pm 1.3)$$

For Group II:

$$X_1 = 4.04 + .002X_2 + .03X_3 \quad (P. E. = \pm .45)$$

In each case:

X_1 = scholastic index

X_2 = caution index

X_3 = intelligence score (or I. Q.)

An inspection of the formulae will show that, for Group II, the caution index is a negligible quantity in prediction and the equation may, therefore, be written:

$$X_1 = 4.04 + .03X_3 \quad (P. E. = \pm .45)$$

In the equation for Group I, the intelligence score is three times as valuable for predictive purposes as the caution index.

In order to make the equations entirely reliable, the P. E. should, in each case, be multiplied by 4 (assuming the normal curve). On this basis, we find the range of variability to be

⁶¹This statement should be explained further by calling attention to the fact that it is practically impossible to get an adequate measure of the number of times a student was placed on probation during his residence in college. Some students enter on probation, and in some years there are more probation periods than others, thus making comparisons between students extremely difficult.

± 5.2 on a scale of 15 points for Group I, which is too large for practical use. For Group II, the range is considerably smaller, being but ± 1.8 on a scale of 10 points. Predictive results, obtained by means of these or similar formulae, might be used to advantage by school authorities in determining the probable scholastic achievement of those who apply for admission, and this would be an additional factor in the information now generally employed in evaluating and rating the candidates for admission to colleges and other schools.

For Group III, the correlations between the caution index and the M. A., and also between the caution index and the I. Q. are rather high ($.60 \pm .03$ and $.61 \pm .04$, respectively.) The difference between the P. E.'s here is due to the fact that, because of defective records, only 127 cases are included in the second correlation. In general, the caution factor seems more evident in persons of high intelligence than in those lower down in the scale. This is to be expected, especially when a group test is given to individuals with a range of intelligence extending from very low to very high, as was the case with Group III. It is conceivable that, where such discrepancies between individuals exist, the less intelligent ones, in addition to whatever natural propensities toward "rashness" they may possess, are spurred on by the activity of the other individuals taking the test and hence take more guesses than they might otherwise do. In a more intellectually homogeneous group this condition would not be so emphasized as where wide variations are present in intelligence levels.

No valid comparison may be drawn between the various sub-groups of Group III, because of the small number of individuals which some of them contain. In Table 16 are given the range and the average of the M. A., the I. Q., and the caution index for each sub-group, from which the reader may make his own deductions. The most interesting point seems to be the fact that, although the ranges vary widely in their limits, the average caution index shows little variation from sub-group to sub-group, with the single exception of the Mental Defectives. Here we find an average caution index of 33.9, which is approximately twice as large as that for the other sub-groups. This is still further evidence to substantiate the hypothesis put forward in the preceding paragraph.

As an illustration of the differences occurring in scholarship between persons with a high caution index and those with a

low caution index, the following may be mentioned: a group of 16 individuals making a low average caution index and one of 17 individuals making a high average caution index, although all were of approximately the same intelligence as evidenced by their scores on the Thorndike intelligence examination, showed a difference of 8.6 points in favor of the more cautious group as regards their average scholastic performance. (See Chapter III, pp. 36 and 37.)

Further instances comparable to the above are presented below, all indicating that the cautious individual (i.e., the one with the lower caution index) stands higher in scholarship.

TABLE 17

(Showing difference in caution indexes and scholastic indexes of pairs of individuals, both with approximately the same intelligence score.)

| <i>Pair No.</i> | <i>Intelligence Index</i> | <i>Caution Index</i> | <i>Schol. Index</i> | <i>Diff. in Schol. Index</i> |
|---------------------|-------------------------------|--------------------------|-------------------------|----------------------------------|
| 1 | 74.8 | 8 | 11.11 | 5.69 |
| | 74.6 | 33 | 5.42 | |
| 2 | 88.2 | 15 | 10.07 | 1.90 |
| | 88.2 | 29 | 8.17 | |
| 3 | 91.0 | 18 | 8.58 | 1.95 |
| | 91.6 | 30 | 6.63 | |
| 4 | 84.0 | 20 | 8.60 | 2.27 |
| | 84.0 | 40 | 6.33 | |
| 5 | 90.0 | 5 | 7.57 | .37 |
| | 90.0 | 12 | 7.20 | |

While the correlations obtained were not high enough to show that the cautious individual invariably excelled in scholarship, they nevertheless served to indicate that the *trend* is in that general direction.

One other example of a slightly different type may be given. Two brothers made scores on the Thorndike examination of 111.8 and 104.4, with caution indexes of 16 and 12 and scholastic indexes of 12.77 and 10.90, respectively. The difference of 1.87 in scholastic performance would not be expected from an inspection of the small differences to be noted in the case of the caution index and the intelligence score. An examination of the scholastic records of the two individuals showed that the one with the lower scholastic index had been compelled, on account of sickness, to be absent from four examinations in one semester. Thus, the difference in scholarship is to be explained on this basis rather than on that of the caution factor or the general intelligence level.

CHAPTER VI

CONCLUSIONS

(1) The caution factor seems to have some influence on scholastic performance, though this fact is more marked in the case of Group I than in that of Group II. In all probability, this difference is due to the differentiating character of the situations placed before the individual taking the Thorndike intelligence examination as contrasted with the average type of situation found in other standard tests.

(2) There seems to be a fairly well defined relationship existing between an individual's score on an intelligence examination and the caution factor, largely because this relationship is made to exist by the technic of scoring employed in dealing with the wrong answers, which, as has been shown, form the basis for computing the caution index.

(3) A still closer relationship than the above may be noted between the scholastic performance and the intelligence rating of an individual, and this is in accordance with the results previously obtained in this connection by other investigators. The caution factor has apparently little influence on the correlation in this case.

(4) The caution factor seems to influence conduct and the time taken for the performance of a given task only slightly, if at all.

(5) The number of the minus scores and the value of the plus scores on the Thorndike examination show some relationship to scholastic performance, but here, as well as in the case of the number of plus scores and the value of the minus scores, the correlations are too low to permit of any definite statement as to how or to what extent scholarship depends upon any of these.

(6) The regression equations for predicting scholarship on the basis of the intelligence score and the caution index have been actually used on various individuals and found to be reliable in every case within the range of the P. E. In the equation for Group II, it will be remembered that the caution factor played such a small part that it was dropped from further consideration, but in the case of Group I it was found

to be worth approximately one-third as much as the intelligence score for prediction purposes. This fact may again be due to the difference in character between the Thorndike test and other tests for intelligence.

(7) In general, the results of the study tend to show that the cautious type of person, other things being equal, is more likely to excel in scholastic performance than one of the opposite type. This statement seems to be borne out by the illustrations already given in both group and individual cases (see pp. 56 and 57.)

(8) Further investigation is needed to show the operation of the caution factor in fields other than that of scholastic performance.

(9) The combination of intelligence tests with those now used for testing character traits should be a feasible extension of the use of tests. Emotional tests, such as the *Downey Will Profile*, might be combined with some one of the present well-known intelligence tests, allowing, of course, for suitable modifications in each, wherever this might appear necessary. Suggestibility tests, tests of aggressiveness, etc., require the use of a certain amount of intelligence on the part of the person taking them, just as intelligence tests, on their part, show unmistakable evidences of certain character traits. If there is, therefore, this degree of overlapping, the possibility of devising tests which will furnish an objective basis for estimating both intelligence and the most important character traits at the same time is by no means a remote one. Entirely new tests may be devised for this purpose without specific reference to those already in use, or some more or less modified combination of the latter may be employed, or even the intelligence examinations, as they now stand, may be further studied for evidences of character traits, such as has been done in the present instance.

(10) Following the analogy of Hart and Spearman, and of Webb⁶², who have introduced the concepts of the "g" and "w" factors as forming the basis of intelligence and character in general, it is suggested that specific character traits, as they are recognized and studied, be denoted by letters of the Greek alphabet, and that, accordingly, the caution factor be called the "Zeta" factor or some similar name.

⁶²Hart, B. and Spearman, C., op. cit.
Webb, E., op. cit.

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